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ABSTRACTS

of recent published material on Soil and Water Conservation

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The classification of articles follows the table of contents used for the "Soil and Water Conservation Research Needs" of the Soil Conservation Service. Abstracted articles are not editorialized and the language of the author is used wherever possible. In foreign articles, the units of measure are converted to usual American units. Tables are included where they help to present the information. When the entire number of a publication is devoted to reviewing one subject then the entire publication is abstracted as one article giving title and authors of each paper included in the publication. Abbreviations of journals and addresses follow U.S.D.A. Misc. Pub. 765, July 1958.

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Charles B. Crook, Soil and Water Conservation Research Division, Agricultural Research Service, U.S. Department of Agriculture, Plant Industry Station, Beltsville, Maryland, 20705.

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WATERSHED ENGINEERING

Watershed Development

Kelly, L. L. ELECTRONIC COMPUTERS IN WATERSHED RESEARCH. J. Irrig. and Drain. Div., ASCE 89 (IR 3): 37-43. Sept. 1963.

Electronic computers have been used by personnel of the Agricultural Research Service to aid in the solution of a variety of problems in soil and water conservation research. The computer has provided increased speed and accuracy in the routine processing of masses of hydrologic data. This processing is accomplished by the use of the chart-reader which transfers, for example, the chart trace values of water stage and time to punch cards, and the electronic computer which makes the necessary computations to convert the basic values to rates and accumulated flow amounts.

The speed and accuracy of the computer makes it possible to conduct analytical studies that, because of the complexities of the computations and masses of numbers involved, would be virtually impossible by hand methods. Computer programs have been written and successfully used to conduct water budget studies and flood routing studies, and to test various mathematical or statistical models of water flow in channels, moisture diffusion in soils, and rainfall-runoff relationships.

It is desirable that the scientist doing research in soil and water conservation should have an understanding of the capabilities of the computer; one way to acquire this understanding is for him to learn to write simple programs. Once this understanding is acquired, the machine will be used most efficiently if the services of a professional programmer can be provided. Finally, while research is greatly aided by the electronic computer, the key element in research is the competent and creative scientist or engineer.

SWCRD, ARS, USDA, Beltsville, Md., 20705

Brewer, D., and Byrd, W. ECONOMIC FEASIBILITY OF SMALL UPSTREAM IMPOUNDMENTS IN THE BIG CREEK WATERSHED. Mo. Agr. Expt. Sta. B. 802, 36 pp. 1963.

The Big Creek watershed comprises 420 square miles in four west central Missouri counties and is part of the larger South Grand River Basin. The area is faced with several watershed problems; however, severe flooding is the more important problem.

Some of the problems faced by the residents of the watershed area were studied to determine the economic feasibility and location of upstream impoundments in the Big Creek watershed area.

The Big Creek watershed area was divided into eight sub-watersheds and the floodplain into eight secondary reaches. These reaches were then combined into the four primary reaches.

Seven of the suggested structures gave a favorable benefit-cost ratio. One did not, but, this structure was believed necessary to give desired protection to the respective reach. These structures appear to be economically feasible. The engineering feasibility of the precise sites remains to be evaluated. If the sites are feasible, about 22,000 acres of land in the combined reaches would receive floodwater protection from construction of the eight suggested retarding structures. The benefits derived from a reduction of flood damages were estimated at $180,249, based on a 70 percent reduction in flood damages with all eight structures in operation. Total annual costs for the structures including the cost of land in the inundated areas, and the cost of constructing the floodwater retarding structures, were estimated at $108,065.

The ratio of benefits to costs for the entire project was a favorable 1.67 to 1. Other benefits, such as urban water supplies from the permanent pools of some impoundments, increased and improved recreational facilities for the area residents and tourists, and a general improvement of economic conditions of the area were not included in the benefits used in calculating the benefit cost ratio.

U. Mo., Col. Agr., Agr. Expt. Sta., Columbia, Mo.

Webster, H. H., and Hagenstein, P. R. ECONOMIC ANALYSIS OF WATERSHED MANAGEMENT DECISIONS--WHAT SORT OF GUIDES FOR LAND MANAGERS? J. Forestry 61: 631-634. 1963.

Land management for the purpose of changing the quality, quantity, and timing of water flows should expand in the future. In economic considerations, land managers probably will be confronted with the following types of decisions: (1) To achieve fixed results at least cost (a least-cost decision); (2) to achieve maximum results from a fixed expenditure (a fixed-expenditure decision); or (3) to select courses of action that promise additional returns greater than the additional costs (a production-goal decision).

For economic analysis of these decisions, several types of data would be required. Physical response data and cost data would be required in all cases. Water-value data would be vital for production-goal decisions, important for a particular class of fixed-expenditure decisions, and unnecessary for least-cost decisions. Problems of measurement must be overcome to obtain physical response and cost data. Problems of both measurement and theory must be overcome to obtain water-value data since water is not generally bought and sold at the watershed. Most decisions made by local managers are least-cost or fixed-expenditure decisions. Therefore, research in the economics of watershed management might best be concentrated first on least-cost and final-expenditure decisions.

Northeastern Forest Expt. Sta., FS, USDA, Upper Darby, Pa.

Hydrology

Cliff, E. P. WATER FOR A NATION'S NEEDS. J. Soil and Water Conserv. 18: 185-189. 1963.

Though research and field experience have provided some solutions to various aspects of water problems in the areas investigated, many other problems must still be studied. The challenge of meeting growing water needs and changing patterns of use must be met if the Nation is to continue to occupy a position of strength and enjoy economic well-being. History records the stories of many civilizations and nations that fell by the wayside because they did not manage their soil and water resources wisely.

This challenge can be met by conceiving and implementing sound programs of water conservation and development and watershed protection, improvement, and management. Such programs must be based upon a thorough technical knowledge; they must be timely, they must involve all appropriate levels of government; and they must be firmly supported by an informed and concerned citizenry.

FS, USDA, Washington, D.C., 20250

Kennedy, E. J. STREAMFLOW RECORDS BY DIGITAL COMPUTER. J. Irrig. and Drain. Div., ASCE 89 (IR 3): 29-36. 1963.

The automation of streamflow-record computation was examined. Records for an increasing number of gaging stations operated by the United States Geological Survey are now being processed automatically by a general-purpose digital computer from charts of new, automatic, digital water-stage recorders. Exhibits from one automated gaging station were used to illustrate the process.

Automatic data processing reduced office work on a typical record from approximately 10 to less than 5 man-days per year. The work performed by the computer was the unpleasant part, namely, the drudgery. Preliminary studies indicated relatively small monetary savings, approximately 10 percent less than for manual computation. Computer mistakes were uncommon and usually more obvious than the mistakes found in manual computation.

Geol. Survey, U.S. Dept. Int., Topeka, Kans.

Trimble, G. R., Jr., Reinhart, K. G., and Webster, H. H. CUTTING THE FOREST TO INCREASE WATER YIELDS. J. Forestry 61: 635-640. 1963.

Results from watershed research on the Fernow Experimental Forest in West Virginia, a mountain hardwood forest in a region of heavy, well-distributed rainfall, were given to help the technician answer questions on the value of cutting the forest to increase water yields. Four degrees of forest cutting, ranging from a commercial clearcutting to a light selection cutting, were made on 40- to 95-acre watersheds.

Increases in water yields were roughly proportional to the amount of timber removed. Increases (and with heavy cutting these were large) came mostly in the growing season--the period of greatest need. Cutting effects on high flows were not great; periods of high flow were more frequent in the dormant season. Vegetation regrowth was rapid and the effects of cutting on streamflow diminished quickly. Water quality was adversely affected by poor logging practices that resulted in erosion and sedimentation. The effects of cutting on water quality were greatest during the period of active logging and diminished soon afterward.

Northwestern Forest Expt. Sta., FS, USDA, Upper Darby, Pa.

Hill, L. W. THE COST OF CONVERTING BRUSH COVER TO GRASS FOR INCREASED WATER YIELD. U.S. Forest Serv. Res. Note PSW-2, 7 pp. 1963.

Gains in water yield were reported at the San Dimas Experimental Forest in southern California after conversion of deep-rooted brush to shallow-rooted grass in a canyon bottom and on side slopes. The conversion program was described and treatment costs were reported. The cost of expected gains in water yield was not competitive with today's cost for water from other sources. Costs of getting more water can be reduced, and the conversion program fitted into multiple-use management.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif.

Geology

Mao, S., and Rice, L. SEDIMENT-TRANSPORT CAPABILITY IN ERODIBLE CHANNELS. J. Hydraul. Div. ASCE 89 (HY 4): 69-95. July 1963.

A procedure that was developed to provide a means of evaluating the need for sediment control for the link canals being constructed in West Pakistan as part of the Indus Basin Project was presented. The procedure utilizes basic concepts of the Einstein bed-load function to evaluate the sediment-transport capability of an erodible channel having variable sediment concentrations and size distributions entering the head reach.

Data for existing canals in West Pakistan were used to illustrate the application of the procedure. The need for further research on this aspect of the sediment-transport problem was recognized.

Hydraul. Engin., Tipton and Kalmbach Inc., Denver, Colo.

Tóth, J. A THEORETICAL ANALYSIS OF GROUNDWATER FLOW IN SMALL DRAINAGE BASINS. J. Geophysical Res. 68: 4795-4812. 1963.

Theoretically, three types of flow systems may occur in a small basin: Local; intermediate; and regional. The local systems were separated by subvertical boundaries, and the systems of different order were separated by subhorizontal boundaries.

The higher the topographic relief, the greater was the importance of the local systems. The flow lines of large unconfined flow systems do not cross major topographic features. Stagnant bodies of ground water occur at points where flow systems meet or branch. Recharge and discharge areas alternate; thus only part of the basin will contribute to the baseflow of its main stream. Motion of groundwater is sluggish or nil under extended flat areas, with little chance of the water being freshened. Water level fluctuations decrease with depth, and only a small percentage of the total volume of the groundwater in the basin participates in the hydrologic cycle.

Groundwater Div., Res. Council Alberta, Edmonton, Alberta, Canada.

Lehr, J. H. MODEL ANALYSIS OF WATER TABLE DRAWDOWN SURROUNDING PUMPING WELLS. J. Soil and Water Conserv. 18: 205-207. 1963.

Because a natural underground hydrologic system cannot be directly observed, it is difficult to comprehend how such a system operates. The effects on the water table level of pumping and artificial recharge of underground aquifers were given. The basic principles discussed have significant implications for all users of underground water.

U. Ariz., Tucson, Ariz.

Engineering Design

Kenny, T. C. STABILITY OF CUTS IN SOFT SOILS. J. Soil Mech. and Found. Div., ASCE 89 (SM 5): 17-37. Sept. 1963.

For excavations in normally consolidated sediments, slope-stability analyses were made for undrained and long-term conditions. Submerged slopes and dry slopes having different seepage patterns were investigated. For long-term conditions, the overconsolidation effect resulting from excavation was studied and found to be generally of negligible importance. The results of these analyses were presented in the form of design curves showing the required slope inclination for different values of s_u/p' for undrained conditions and different values of ϕ_d for long-term conditions. Available field evidence was presented and none of the evidence conflicted with the results of the stability analyses. It was concluded that both the undrained case and the long-term case can provide the most critical conditions for slope stability of open excavations.

Norwegian Geotech. Inst., Oslo, Norway.

Knapp, J. W., and Schaake, J. C., Jr. MEASURING RAINFALL AND RUNOFF AT STORM-WATER INLETS. J. Hydraulics Div. ASCE 89 (HY 5): 99-115. Sept. 1963.

Relatively simple instrumentation was developed to measure and record rainfall and runoff on small urban areas draining to storm water inlets. The instruments include a tipping bucket rain gage, weirs, and head sensing devices installed inside storm water inlets, and a multiple pen recorder. Runoff into as many as six storm water inlets is recorded at a single location. Controls are provided to operate the instruments automatically during storms. The occurrence of rainfall and runoff closes switches, sending pulses to the recording pens, and a synchronous record of the events is compiled on a single continuous chart. A chart speed of 1-1/2 in. per min. permits evaluation of the data in small increments of time. Power is obtained from a 12-VDC storage battery.

The equipment is designed to be installed with little modification of existing drainage facilities. Field tests and model studies were used to determine discharge characteristics of the inlet weirs.

Johns Hopkins U., Baltimore, Md.

Diskin, M. H. TEMPORARY FLOW MEASUREMENT IN SEWERS AND DRAINS. J. Hydraul. Div. ASCE 89 (HY 4): 141-159. July 1963.

Temporary flow measurement in circular channels, such as sewers and drains, as well as in sewers of other cross sections, can be carried out by introducing into the flow a pier-shaped element with a bottom rounded to fit the circular invert of the channel. The reduction in the area of flow will cause a critical section to develop in the throat so formed, giving a functional relationship between the discharge and the critical depth at the throat and also between the discharge and the depth at an upstream section adopted as a measuring section.

The device is, in effect, a critical depth flume, or a Venturi flume, with an irregularly shaped throat composed of two openings on either side of the element introduced. Applying the theory of critical depth flumes, equations are derived relating the discharge to depth at the measuring section; the equations are solved numerically, making use of standard tables of properties of parts of a circle.

The results of experiments performed on the proposed measuring device indicated fairly close agreement between the measured and the calculated rates of flow, most values of the coefficient of discharge falling in the range of 0.90 to 1.00. The experiments included tests on four measuring devices, two in each of two circular channels 10 in. and 16 in. in diameter.

U. Ill., Urbana, Ill.

Carter, R. W., and Anderson, I. E. ACCURACY OF CURRENT METER MEASUREMENTS. J. Hydraul. Div. ASCE 89 (HY 4): 105-115. July 1963.

The probable accuracy of a stream-flow measurement made by the current-meter method at a gaging site that was selected at random was evaluated. Standard deviation of discharge-measurement errors in percent of mean was determined from the variance of the partial errors. Variances of the partial errors resulting from the current meter, by velocity fluctuations, by the shape of the vertical velocity curve, and by the number of observation stations in the section were defined by special measurements on many different streams. The information can be used to determine the observation procedure necessary to obtain a given accuracy of measurement.

The following conclusions were made:

1. The Price current meter was not affected by stream turbulence and measured the true velocity within 1 percent.
2. Velocity fluctuations about the mean at a point in the section were random in time and space.
3. The average of the 0.2 and 0.8 velocities closely approximated the mean velocity in the vertical.
4. If single discharge measurements were made at a number of gaging sites by the usual 0.2 to 0.8 method (using 30 stations and 45-sec observations), the errors of two-thirds of the measurements would be less than 2.2 percent.

U.S. Geol. Survey, U.S. Dept. Int., Washington, D.C.

Pickard, W. F. SOLVING THE EQUATIONS OF UNIFORM FLOW. J. Hydraul. Div. ASCE 89 (HY 4): 23-38. July 1963.

The differential equation governing the flow of liquid in an open channel was shown to lead naturally to 12 different types of stream-depth profiles. When this equation was transformed to a form suitable for integrating, the 12 profiles led to 4 different integrals of two terms each. It was shown that any of the integrals was simply expressible in terms of one of three higher transcendental functions, the backwater integrals of the first, second, or third kinds. The latter functions were considered in detail for the parameter ranges of interest in hydraulics. Functions of the second kind were integrated in closed form. Functions of the first and third kinds were expressed in terms of a finite series of polylogarithms and polynomials of moderate order.

Practical evaluation methods were presented, and emphasis was placed on techniques suited for use with high speed digital computers.

Gordon McKay Lab., Harvard U., Cambridge, Mass.

Mirajgaoker, A. G., and Charlu, K. L. N. NATURAL ROUGHNESS EFFECTS IN RIGID OPEN CHANNELS. J. Hydraulics Div. ASCE 89 (HY 5): 29-44. Sept. 1963.

The effects of large natural roughness in open channel flow were studied. There was an attempt to create conditions of boulder streams by fixing natural stones, from 2-1/2 in. to 3 in. in diameter, to the bed of a 3-ft. wide rigid bed flume. Six different patterns of boulder placements were tried, and the roughness densities varied from 15 stones per sq. yd. to 114 stones per sq. yd.

Chezy's resistance function and the relative roughness parameter was related by a logarithmic formula and the general resistance diagram, relating the resistance function and the Reynolds number, was also applicable for large natural roughness elements. A new roughness density parameter was introduced which was found to have a consistent relation with the resistance function and which indicated the number of stones per unit area of the channel bed.

Results were compared with those of previous investigators who have conducted experiments with idealized geometrical elements.

U. Roorkee, Roorkee, India.

Behnke, J. J., and Schiff, L. HYDRAULIC CONDUCTIVITY OF UNIFORM, STRATIFIED, AND MIXED SANDS. J. Geophysical Res. 68: 4769-4775. 1963.

Hydraulic conductivities and velocities for the lower limits of very coarse, coarse, medium and fine sands (U.S.D.A. classification) were determined from a model study using transparent plastic cylinders.

In uniform sands, the velocity under 1.0 ft. of surface head ranged from 43 to 2118 ft./day and the hydraulic conductivity ranged from 19 to 970 ft./day for the fine and very coarse sands, respectively. Velocity values in four successive stratified layers of equal thickness were essentially equal in magnitude and closest to those determined for the uniform, fine sand. The velocity in a stratified medium composed of a 'limiting layer' of medium sand placed between two layers of very coarse sand was 10.4 percent of the velocity calculated for an equivalent thickness of the coarse sand alone. Hydraulic conductivity and velocity values in a mixture composed of 25 percent of each of the four sizes were nearly identical to the values determined from a uniform, fine sand. The velocity in a binary mixture composed of 65 percent very coarse and 35 percent fine was only 9.3 percent greater than the velocity for the fine sand alone. Values for other binary mixtures were included.

Application of the data to the design and performance of recharge facilities was discussed.

SWCRD, ARS, USDA, Fresno, Calif., 93726

Snow Surveys

Court, A. SNOW COVER RELATIONS IN THE KINGS RIVER BASIN, CALIFORNIA. J. Geophysical Res. 68: 4751-4761. 1963.

Snow cover of the Kings River basin in the southern Sierra Nevada (California) decreases each spring at the rate of about 18 mi. ^{2}/day. Since the hypsometric ('area-elevation') relation for the basin is almost linear from 7,000 to 11,000 ft. (1,000 to 200 mi.^{2}), the 'equivalent snowline' rises about 70 ft./day each spring, regardless of the actual amount of snow. Water content of the snowcourses in the basin increases 4 to 5 inches per thousand feet up to at least the 9,000-ft. level. The courses, however, apparently contain snow more representative of average conditions some 2,600 ft. higher than their actual elevations. These relations have been deduced from estimates of the snow-covered area of the basin made each spring; from readings of the 18 snowcourses in the basin, read one or more times each spring; and from the daily weather observations at Grant Grove.

Geophysics Lab., Lockheed-Calif. Co., Burbank, Calif.

WATER MANAGEMENT

Irrigation

Kimball, N. D., and Castle, E. M. SECONDARY BENEFITS AND IRRIGATION PROJECT PLANNING. Oreg. Agr. Expt. Sta. Tech. B. 69, 35 pp. 1963.

The concluding report of an intensive research study of the North Unit Deschutes Irrigation Project, located in Jefferson County, Oreg., was given. The secondary benefits on the project and the implications of the project experience to the planning of future projects were reported. The authors concluded that:

1. The case for national indirect or secondary benefits from irrigation projects must rest largely on the existence of excess capacity in the local area, except under conditions of depression or inflation.
2. Excess capacity existed in this area prior to the establishment of the project.
3. Considerable benefit does accrue to a local area in addition to the primary beneficiaries.
4. Increased agricultural production in Jefferson County resulting from the North Unit Project caused an increase, but a less than proportionate increase, in employment, population, and retail sales.
5. The originally established farming units contained too few acres of land. Larger units would have been more successful.
6. Beginning acreage and beginning net worth were important factors explaining farming success.
7. Numerous farmers discontinued farming. The failure rate was approximately twice that for farmers in the remainder of Oregon.
8. Despite the large number of displaced farmers, sufficient business activity was stimulated in the area to create more than enough employment to accommodate those farmers forced to seek employment off the farm.

Agr. Expt. Sta., Oreg. State U., Corvallis, Oreg.

Carreker, J. R. THE RELATION OF SOLAR RADIATION TO EVAPOTRANSPIRATION FROM COTTON. J. Geophysical Res. 68: 4731-4741. 1963.

Evapotranspiration is a major factor in determining irrigation requirements of crops. Estimates of E_T have been made by many investigators on the basis of combinations of factors including temperature, duration of sunlight, wind speed, vapor pressure deficit, and other measurements. In all these methods, use is made of complicated formulas or climatic data that are not readily available. A simple method is needed for determining E_T.

Rates of E_T determined from small irrigated cotton plots at Watkinsville, Georgia, by direct soil moisture measurement showed that the daily rate varied from 0.07 in./day soon after planting to 0.27 in./day during the period of heaviest fruiting.

The evapotranspiration equivalent of solar radiation (Rs) measured at Atlanta, Ga., was related to the measured E_T from cotton, and a ratio of E_T/Rs was developed. The ratio varied from 0.3 on June 1 to 0.75 on August 10.

Solar radiation data, readily available from the U.S. Weather Bureau at many points throughout the United States, can be converted to evapotranspiration equivalent (Rs) quite easily.

Examples were given for converting solar radiation to Rs and water requirements of crops and for determining irrigation needs when solar radiation, daily rainfall, and available water capacity of the soil were known.

SWCRD, ARS, USDA, Athens, Ga., 30601

Schleusener, P. E., and Kruse, E. G. EMPIRICAL FORMULA FOR COMPUTING WATER NEEDS OF A ROW CROP. Trans. ASAE 6: 140-141, 144. 1963.

An equation was developed for computing daily evapotranspiration rates of a row crop on a field basis. The equation was developed and tested with hydrologic data obtained from irrigated fields in western Nebraska. The equation was then used to determine the number of irrigations and the amount of irrigation water required for corn on a sandy loam soil with a low water-holding capacity. The equation shows promise of being useful in the North Central United States.

U. Nebr., Lincoln, Nebr.

Grover, B. L., and Hotchkiss, C. W. AN ELECTRIC POINT GAUGE AND TUBE ORIFICE PLATES FOR MEASURING FLOW RATES IN FURROW IRRIGATION. Soil Sci. Soc. Amer. Proc. 27: 584-586. 1963.

The descriptions of an electric point gauge and tube orifice plates for determining furrow flow rates were given. The gauge is a double-pointed unit, constructed so that the head loss across the orifice plate is obtained as a single reading. The equipment was particularly useful in the evaluation of intake rates in furrow irrigation on small experimental plots, since it was used with little or no damage to the plots.

U. Calif., Riverside, Calif.

Blake, D. N. DESIGN OF METAL PIPE FOR IRRIGATION STRUCTURES. J. Irrig. and Drain. Div., ASCE 89 (IR 3): 45-51. Sept. 1963.

Two new developments in fabricating corrugated metal pipe (CMP), plus a study of changes in the corrugation configuration, result in a better finished product than that which has been produced by the riveting method. The lockseam method, which produces continuous corrugated pipe from coil stock in a variety of depths and pitches in the corrugation, reduces the leakage factor to a greater extent than does the lapseam riveting method. The spotweld method, as now used, has shown greater seam strengths. The study of new coatings to replace or improve present bituminous coatings, and the ability to develop greater strengths in lighter gage material by the changing of corrugation configuration, will expand the use of CMP in the irrigation field, as well as in other fields.

Culvert Div., Eaton Metal Products Corp., Omaha, Nebr.

Davis, S., and Willhite, F. M. BORDER-BASIN IRRIGATION ON MOUNTAIN MEADOWS. Agr. Engin. 44: 545. 1963.

Often more water is applied to mountain meadow areas than is needed. In addition to the loss by transpiration from low-quality, non-palatable plants, evaporation from free water surfaces and deep percolation losses are great. When water is used efficiently, the meadow produces good yields of high-quality forages; and extra water is released for other beneficial uses.

Border or basin irrigation systems have not been used extensively to irrigate mountain meadows because the initial expense is high and soils are often shallow or steep, making leveling operations difficult.

Water may be controlled against sideslope by installing small guide borders at frequent intervals. These do not materially interfere with crop management and give water control on sideslopes with little land leveling, providing the grade between border ridges is near zero. Spacing of contour ditches and reducing sideslope permit efficient irrigation of sod crops without expensive land leveling.

A border-basin experiment was described that cost about $5 per acre for good water control. To prepare this entire field for border irrigation on a slope for which borders are recommended would cost about $150 per acre. If the complete field was leveled for borders and good water control, the cost would probably be near $200 per acre.

SWCRD, ARS, USDA, Riverside, Calif.

Wiersma, J. L. SPRINKLER IRRIGATION MANAGEMENT. S. Dak. Agr. Expt. Sta. B. 507, 21 pp. 1963.

Successful sprinkler irrigation systems supply correct amounts of water to crops when water is needed and at a runoff preventing rate. Design and management are planned so this can be done with the least possible equipment and at the lowest possible pumping or delivery rate.

Irrigation farming is planned on the basis that water and available plant food are no longer limiting production factors. Solar energy for plant growth then becomes the most limiting factor. Most of South Dakota receives enough solar energy to use about 30 inches of water per growing season. Irrigation is planned to supplement the part retained from natural rainfall. Conservation of natural rainfall is just as important to the irrigation farmer, as it is to the dryland operator.

Efficient management of a sprinkler system requires: (1) Using the root zone for a water reservoir; (2) pumping the maximum number of hours per day; (3) applying water as efficiently as is humanly possible; (4) properly using a correctly designed system; (5) growing crops having peak water needs at different times; (6) using labor efficiently and (7) using every means available to conserve natural rainfall.

The results of irrigation tests on sprinkler management on Fordiville sl and Volga sicl in South Dakota were given.

Agr. Expt. Sta., S. Dak. State College, Brookings, S. Dak.

Meyer, J. L. TRACTOR TOW SPRINKLER SYSTEM FOR GRAPES. Irrig. Engin. and Maintenance 13 (5): 17-18. 1963.

A tractor towed system of sprinkler irrigation was tested in a new vineyard in Salinslaus County, Calif. The couplings of a conventional system were fitted with two-wheel dollies. The lateral sprinkler lines trail perfectly from one setting to another.

Underground main lines with risers every 60 feet allow attachment at either end of the laterals. Neither tractor nor man traverse wet ground. The tractor driver only steps off to disconnect and reconnect the lateral lines.

Before planting the vineyard, a preliminary study comparing land grading costs and border check (flood) irrigation pipeline costs to the costs of a semi-automatic tractor tow sprinkler system was made. Land grading and flood irrigation costs far exceeded the initial costs of sprinkling. Land grading would have cost $125 to $150 per acre and the concrete pipeline system $100 per acre additional. The sprinkler system, complete with underground main lines and pump, cost $170 per acre. The initial savings of $55 to $80 per acre and the fact that land grading often damages soil structure and water infiltration appealed to the grower.

After 4 full years of operation, the 140-acre sprinkler system was compared with the cost of operating the sprinkler against an adjacent border check irrigation system on the same ranch. The results are given in the following table.

OPERATIONAL COSTS FOR 1962 SEASON TRACTOR-TOW
VS. BORDER CHECK IRRIGATION

Cultural Operations	Sprinkler/Acre	Border Creek (Flood)	
Irrigation (four times)			
Irrigator*	$ 3.00 man	$ 4.00	
Tractor*	8.00 tractor	....	
Ridger and smooth (four times)	....	12.00	tractor & driver
Electricity (low-lift pressure pump)	5.80	....	
Sub-total	$16.80	$16.00	
Water tax/acre, Turlock Irrig. Dist. (land tax/acre)	1.50	1.50	
Cultivation			
Two discings	8.00	8.00	
Three harrowings	6.00	6.00	
Total	$33.30/A	$31.50/A	

*Man hours at $1.50/hour, tractor $4/hour.

Farm Advisor, Agr. Ext. Serv., Stanislaus Co., Modesto, Calif.

Benz, L. C., Mickelson, R. H., Jensen, M. E., and Sandoval, F. M. SMALL AND LARGE-DIAMETER, WATER-TABLE OBSERVATION WELLS COMPARED. Trans. ASAE 6: 93-94, 97. 1963.

The comparative sensitivity and costs of 3/8 and 4-in. diameter shallow observation wells were elevated. Small wells in fine-textured soils gave a better estimate of the water table and were more responsive to influences causing fluctuations. The small well was also more economical to install.

Both large and small diameter wells had their own peculiar advantages and disadvantages, depending on the primary purpose of the well. Large diameter wells permitted collection of large water samples with relative ease and also provided the opportunity to collect large soil samples for visual and/or laboratory analysis.

Observation wells should not extend below the lowest expected elevation of the water table to minimize the influence of artesian pressures.

SWCRD, ARS, USDA, Grand Forks, N.D., 58201

Sylvester, R. O., and Seabloom, R. W. QUALITY AND SIGNIFICANCE OF IRRIGATION RETURN FLOW. J. Irrig. and Drain. Div., ASCE 89 (IR 3): 1-27. Sept. 1963.

A study of irrigation return flow in the Yakima River Basin showed that return flow was the major factor influencing Yakima River water quality. The increase in the quantity and composition of salts in the return flow was due more to leaching than to evapotranspiration. Water quality changes occurring during irrigation were examined together with techniques and objectives for return flow quality studies.

Data were presented on water and salt budgets together with the ion concentrations in the applied water, the subsurface, and the surface drainage water. Salts leached and exchanged from the soil and released to the parent river in the irrigation and nonirrigation seasons were reported on a weight-per-acre basis.

The impact of domestic sewage and industrial effluents on river chemical quality was but a small fraction of that due to return flow. Sixty-one percent of the lower river salt content by weight was contributed by return flow in the irrigation season and 49 percent in the nonirrigation season.

U. Wash., Seattle, Wash.

Bradford, G. R. LITHIUM SURVEY OF CALIFORNIA'S WATER RESOURCES. Soil Sci. 96: 77-81. 1963.

Four hundred water samples, representative of the water resources of California were analyzed for their lithium content. Lithium concentration versus geographical area and relation to other cations were discussed. Approximately 25 percent of the samples contained more than 0.05 p.p.m. lithium, and may, therefore, produce undesirable effects on the growth of citrus and other lithium-sensitive crops where soil type and other factors favor lithium accumulation. Samples with a high lithium content were more frequently observed to be associated with low magnesium and/or a high sodium percentage.

The many natural occurrences of toxic levels of lithium in irrigation water, and the possibility of contaminating water supplies from industrial uses of lithium compounds, suggests the need for routine analysis of water samples for lithium by agencies responsible for maintaining water-quality standards.

U. Calif., Riverside, Calif.

Kaddah, M. T. SALINITY EFFECTS ON GROWTH OF RICE AT THE SEEDLING AND INFLORESCENCE STAGES OF DEVELOPMENT. Soil Sci. 96: 105-111. 1963.

The effects of salinity on germination, and on the seedling and inflorescence stages of growth of rice were studied in three experiments. Interaction of irrigation and drainage frequency with salinity at the latter stage of growth were also studied. These experiments showed that:

1. Salinity levels in irrigation waters up to 2,000 p.p.m. resulted in delayed germination but had little effect on percentage germination of Agami, Arabi, and Nahda rice varieties.
2. Young rice seedlings were highly sensitive to salt. When chlorides formed the dominant anions in the soil solution, any slight increase in its specific electrical conductivity above 3.5 to 4 mmho./cm. at 25° C. was very harmful to the newly germinated seeds.

3. Rice varieties differed in their tolerance to salt at the seedling stage. The order of tolerance might not conform with the known varietal order for grain production when salinity is introduced after the seedling stage.
4. Nahda rice seedlings were much more tolerant to sulfates than to chlorides at equal osmotic concentrations. Addition of 10 me./1. $NaHCO_3$ to irrigation water was very harmful to the young rice seedlings.
5. Nahda rice showed relatively high tolerance to salt at the inflorescence stage of growth. Renewal intervals of irrigation water that varied from 1 to 6 days at that stage resulted in little effect on growth and grain yield.

Soil Salinity Lab., Bacos, Alexandria, Egypt, U. A. R.

Chaudhry, M. S., and McLean, E. O. COMPARATIVE EFFECTS OF FLOODED AND UNFLOODED SOIL CONDITIONS AND NITROGEN APPLICATION ON GROWTH AND NUTRIENT UPTAKE BY RICE PLANTS. Agron. J. 55: 565-567. 1963.

A greenhouse experiment in which rice was grown both under flooded and unflooded soil conditions was conducted to examine some possible causes for the common observation that submergence is the key to successful rice culture. Nitrogen was applied at different stages of plant growth in order to obtain information on how the rice crop might perform under the different soil conditions imposed.

Plants grew better under flooded conditions than under unflooded conditions. They were healthier and taller and the effective tillers were thicker and more numerous under flooded conditions. This was accompanied by the development of more fibrous and apparently healthier roots of higher cation exchange capacity (CEC). The most striking effects of the unflooded conditions were: Delayed flowering; very high percentage of sterility; and a significant reduction in grain yields. Application of nitrogen generally increased the CEC of roots but increased yields significantly only when applied to the flooded soil at the tillering state. Low phosphorus and manganese contents of the plant were associated with poor performance of rice grown under unflooded conditions, but other recent observations suggest that they were not basic causes of the adverse plant growth under unflooded conditions.

Jr. Author, Ohio State U., Ohio Agr. Expt. Sta., Wooster, Ohio.

Loomis, R. S., and Worker, G. F., Jr. RESPONSES OF THE SUGAR BEET TO LOW SOIL MOISTURE AT TWO LEVELS OF NITROGEN NUTRITION. Agron. J. 55: 509-515. 1963.

Sugar beet plants grown at two levels of nitrogen nutrition were subjected to low soil moisture in a field experiment. Both N deficiency and moisture stress reduced growth and increased (on a fresh basis) the sucrose concentration in roots. These effects were independent and additive. Beet purity and sucrose yield were increased by N deficiency but not by moisture stress. Allowing sugar beets to wilt just before harvest, by discontinuing irrigation, did not increase yield or quality. A commercial grower might still find some advantage through lower production costs.

Changes in sucrose concentration (fresh basis) which occurred with moisture stress and N deficiency appeared to be determined by changes in the osmotic and turgor relationships within the roots.

U. Calif., Davis, Calif.

Herron, G. M., Grimes, D. W., and Musick, J. T. EFFECTS OF SOIL MOISTURE AND NITROGEN FERTILIZATION OF IRRIGATED GRAIN SORGHUM ON DRY MATTER PRODUCTION AND NITROGEN UPTAKE AT SELECTED STAGES OF PLANT DEVELOPMENT. Agron. J. 55: 393-396. 1963.

Effects of N fertilization of irrigated grain sorghum were studied at Garden City, Kans., for a 3-year period, 1958-60. Dry matter production and N uptake were determined at selected stages of plant development. Recovery of applied N was determined at harvest.

Dry matter production, N content of plant material, and rate of N uptake were generally increased by applied N at all stages of plant development.

Plant growth was slow from seedling emergence through crown root stage: (1) Daily dry matter production was 30 to 50 pounds per acre; (2) daily N uptake averaged about 1 pound per acre; and (3) N content of plant material averaged 3.1 percent.

Plant growth was extremely rapid from crown root to flowering stage: (1) Maximum daily dry matter production ranged from 240 to 340 pounds per acre; (2) maximum daily N uptake increased to 4 to 6 pounds per acre; and (3) N content of plant material declined to 1.4 to 2.2 percent.

Maximum total dry matter production and N uptake occurred 92 to 97 days following seedling emergence except where soil moisture and N were at a high level. This period approached the hard-dough stage of grain development.

Significant losses of N and, to a lesser extent, losses of dry matter occurred during the period of maturity to harvest when soil moisture and N was exhausted. Losses were presumed to be associated with plant respiration and translocation of soluble plant constituents during the maturation process. Losses were not completely accounted for by weathering after maturity. When adequate soil moisture and adequate N were both available in the latter portion of the season, the loss of dry matter and N did not occur.

One pre-plant irrigation prevented severe moisture stress until plants were approaching the boot stage of development. Nitrogen stress on unfertilized plots developed by about the fourth week of growth (crown root stage).

Applied N increased the N content of both forage and grain. N content of forage at harvest averaged 0.41 to 0.67 percent and grain N averaged 1.14 to 1.56 percent. Recovery of applied N in the aboveground portion of plants at harvest ranged between 37 and 83 percent. Recovery was greatest for the 40-pound per acre N treatment.

J. T. Musick, SWCRD, ARS, USDA, Bushland, Tex., 79012

Kempen, H. M., Miller, J. H., and Carter, L. M. PREEMERGENCE HERBICIDES INCORPORATED IN MOIST SOILS FOR CONTROL OF ANNUAL GRASS IN IRRIGATED COTTON. Weeds 11: 300-307. 1963.

Herbicide performance was markedly altered by: Soil incorporation, depth of incorporation; crop seed placement; soil type; and rainfall. Of the 25 herbicides studied, CDAA and CIPC and mixtures of them showed the most promise. Herbicide-placement studies showed that the selectivity of these herbicides in cotton largely depended on herbicide placement in relation to the crop seed and on rainfall. Without rainfall, CDAA incorporated in moist soil above the cotton seed provided excellent weed control with minimal injury to cotton. CDAA was readily leached from the zone of germinating weed seed by rain or irrigation on coarse-textured soils. Without rainfall, CIPC was slightly inferior to CDAA in weed control but more stable in performance over a wider range of environmental conditions. Mixtures of CDAA and CIPC were somewhat superior to either alone. Commercial usage of these herbicides in moist soils will depend on the development of suitable equipment for application.

U. Calif., Davis, Calif.

Hobbs, E. H., Krogman, K. K., and Sonmor, L. G. EFFECTS OF LEVELS OF MINIMUM AVAILABLE SOIL MOISTURE ON CROP YIELDS. Canad. J. Plant Sci. 43: 441-446. 1963.

Eight crops commonly grown in southern Alberta were irrigated when available moisture within the root zone had been depleted to 75, 50, and 25 percent levels. Over a 3-year period, the yields of alfalfa, wheat, barley, sugar beets, corn, peas, and sweet clover reached a maximum at or below the 50 percent level of minimum available soil moisture. Potatoes produced highest yields at the 75 percent level. The relationship between availability of water to the crop and the amount of water in the soil was shown to be somewhere between the concepts of constant availability and linear decrease and was not consistent among the various crops.

Canada Agr. Res. Sta., Lethbridge, Alberta, Canada.

Hughes, W. F., and Magee, A. C. PRODUCTION PRACTICES AND SPECIFIED COSTS OF PRODUCING WHEAT AND GRAIN SORGHUM ON IRRIGATED FARMS, UPPER TEXAS PANHANDLE, 1960-61. Tex. Agr. Expt. Sta. MP-656, 22 pp. 1963.

The absence of high value per acre crops and high well construction costs combined to delay irrigation development in the Upper Texas Panhandle. Drouth during the early 1950's stimulated a rapid expansion of irrigation during this period. After 1957, improved moisture conditions, curtailed supplies of natural gas for pumping, and lower farm commodity prices materially reduced the rate of irrigation expansion.

With irrigation, the volume of farm business, both costs and production, was materially increased with no increase in the size of the farm in terms of acreage.

Winter wheat and grain sorghum are the principal irrigated crops, occupying 95 percent of the irrigated cropland.

In addition to the water and fertilizer used on irrigated crops, power and labor use were doubled and tripled, respectively; seeding rates were doubled; and a much greater use of crop insurance, at higher insured values per acre was made with irrigated than with dryland crops.

Average yields of irrigated wheat are almost three times those under dryland conditions and yields of irrigated grain sorghum are more than five times those on dryland. On the average, irrigated wheat and grain sorghum yields exceed average dryland yields by 20 bushels and 4,200 pounds per acre, respectively.

Gross water application approximates 13 acre-inches per acre each on wheat and grain sorghum.

The investment in irrigation facilities ranged from $21 to $162 per acre irrigated, with an average development cost of $53 per acre irrigated in 1960. The higher irrigation development costs per acre generally were associated with low-capacity wells serving less than the average number of acres irrigated per well. The average annual overhead cost was about $5.80 per acre irrigated in 1960.

The direct cost of pumping water is related closely to the price paid for fuel and well capacities. With natural gas priced at 30 cents per thousand cubic feet (M), the direct cost per acre-inch of water pumped ranged from 25 cents with a 1,500 g.p.m. capacity well to 85 cents with a well with 250 g.p.m. capacity.

Investment, oil, maintenance, and repair costs were similar on pumping plants fueled by L.P. and natural gas, but fuel costs with L.P. gas were higher. With L.P. gas at 8 cents per gallon and natural gas at 20 cents per M, the fuel costs per acre-inch pumped with L.P. gas were three to five times those with natural gas.

With a 750 g.p.m. capacity well and natural gas priced at 30 cents per M, the direct water cost was 42 cents per acre-inch pumped or $5.29 per acre for 13 acre-inches of water. The direct water cost per acre ranged from $3.15 with a well of 1,500 g.p.m. capacity to $10.70 with a well yielding 250 g.p.m.

Specified production costs for irrigated wheat and grain sorghum were each approximately $37.00 per acre, or 5.4 times the specified production costs per acre incurred in the production of the same crops on dryland.

At 1961 prices, an average yield of irrigated wheat and grain sorghum of 28.9 bushels and 26.8 hundredweight, respectively, was required to defray the added specified costs associated with irrigation.

Tables, graphs, and maps.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Prine, G. M., Gardner, F. P., and Willard, C. J. IRRIGATION AND NITROGEN TREATMENT OF FORAGE CROPS. Ohio Agr. Expt. Sta. Res. C. 119, 35 pp. 1963.

Irrigation and nonirrigation on timothy, orchardgrass, bromegrass, and bluegrass gown in pure stand with several rates of nitrogen fertilization and in mixtures with alfalfa, birdsfoot trefoil, and Ladino clover were compared in Experiment I. Plots were cut monthly during the growing season to simulate rotational grazing. Irrigation of alfalfa alone and mixed with timothy and bromegrass both with and without red clover, cut three times yearly for hay was studied in Experiment II.

The yield increases from irrigation varied widely with species and frequency of cutting. Nitrogen fertilized grasses and Ladino clovergrass mixtures gave the largest increases in yields from irrigation. Timothy and Ladino clover were the species most responsive to irrigation.

Irrigated forages were more productive than nonirrigated forages during the dry part of summer but were less productive in the early spring period following irrigation. The nonirrigated grasses yielded more than irrigated in the spring because of the carryover of unused nitrogen. Alfalfa, and probably the other crops, were weakened by irrigation reducing carbohydrate storage for the roots.

The yields of dry matter and protein and the protein content of grasses were progressively increased as the level of nitrogenous fertilizer was raised. Nitrogen and irrigation were complementary during the drought period in 1956-57 when bromegrass and orchardgrass receiving 240 pounds per acre of nitrogen gave the largest gains from irrigation in Experiment I. The average protein yield of the four grasses was doubled by 120 pounds nitrogen per acre.

Birdsfoot trefoil grew satisfactorily under both irrigated and nonirrigated conditions. Ladino clover was most favorably maintained under irrigation. Alfalfa decreased in vigor and stand with frequent cutting under irrigation especially in mixture with bluegrass and orchardgrass.

Irrigation was of greatest value during abnormally long periods of low rainfall and high evapotranspiration on soils of low water-holding capacity. To gain the maximum benefit from irrigation of forages in humid regions, varieties adapted to irrigated conditions should be used and proper management of irrigated forage crops must be made. The economic feasibility of irrigating forage crops in Ohio is questionable. Certainly all other methods of increasing yields, such as fertilization and management, must be taken care of first.

Five alfalfa mixtures in Experiment II were cut as hay under normal rainfall and normal rainfall plus supplementary irrigation. The 3-year average gain for irrigation was 1,280 pounds per acre. Irrigated alfalfa managed as hay did not show a yield decrease in the following spring, as happened in Experiment I.

Gypsum moisture blocks were placed at 6, 10, 20, 40, and 60-inch soil depths in selected nonirrigated plots. More favorable soil moisture conditions were maintained over a longer period of time, when birdsfoot trefoil (deep-rooted) was grown in mixtures with bluegrass (shallow-rooted) than when bluegrass was grown with Ladino clover (shallow-rooted).

Deep-rooted, drought resistant alfalfa and birdsfoot trefoil removed soil moisture slowly and rather uniformly from 6, 10, 20, 40, and 60-inch depths. The presence of some available soil water throughout the root zone of these crops for long dry periods seems to be a primary reason for their good growth during droughts. However, in unusually long droughts growth of these deep rooted crops was reduced. This uniform depletion of water from a large volume of soil suggests that infrequent heavy irrigations would suffice for alfalfa and birdsfoot trefoil.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Leamer, R. W. EFFECT OF FERTILIZATION ON YIELD ON AN IRRIGATED MOUNTAIN MEADOW. J. Range Mangt. 16: 204-208. 1963.

Fertilizer was applied to an irrigated meadow in a mountain valley in northern New Mexico annually for 4 years. Hay yields cut July 1 and regrowth sampled September 15 increased linearly with the amount of nitrogen applied. Applications made March 1 were as effective as those made April 15. Split applications (half on March 1 and half April 15) showed no advantage over single applications. The protein content and total protein yield followed the same linear response pattern to the total amount of nitrogen applied. Yield and protein content of regrowth were increased by a July 1 fertilization, but the increase in protein was less than the increases in yield and protein content in the hay crop when all the nitrogen was applied in the spring.

Neither phosphorus nor potassium increased the yield or protein content of the grasses grown.

Recovery of applied nitrogen increased in successive years. However, when nitrogen rates were doubled in 1961, the percentage of recovery decreased.

SWCRD, ARS, USDA, Weslaco, Tex., 78596

Craigmiles, J. P., and Crowder. L. V. EFFECT OF IRRIGATION AND RATE AND TIME OF NITROGEN APPLICATION ON TEMPORARY WINTER GRAZING. Agron. J. 55: 507-509. 1963.

Two experiments were conducted over a 6-year period (1953-59) at Experiment, Ga., to study the effect of supplemental water and the rate and time of applying N on the forage production and protein content of an oats, ryegrass, and crimson clover mixture.

No significant differences in total forage production were obtained by splitting the N as compared to applying all at seeding time. These results were obtained on the irrigated and nonirrigated plots, indicating that the loss of N by leaching on Cecil c soil was at a minimum.

A 46 percent increase in forage production was obtained by early December during the 6-year period by applying supplemental water. The over-all increase in forage yield for the season totaled 17 percent. Crimson clover was thinned at 32 pounds of N and eliminated when more than 48 pounds of N were applied. Winter killing of the oats occurred when more than 150 pounds of N were applied to the irrigated plots and when more than 180 pounds were applied to the nonirrigated plots.

When 64 pounds of N were applied at the time of sowing, the crude protein content of the forage was 24 percent during the fall and early winter, 18 percent in the winter, and 15 percent in the spring.

Ga. Agr. Expt. Sta., Experiment, Ga.

Reutlinger, S., and Seagraves, J. A. A TECHNIQUE FOR ESTIMATING RETURNS ON INVESTMENTS IN IRRIGATION SYSTEMS FOR FLUE-CURED TOBACCO. N.C. Agr. Expt. Sta. Tech. B. 153, 69 pp. 1963.

A method for evaluating the returns due to supplemental irrigation with particular emphasis on returns for tobacco was given. Additional yield due to irrigation was estimated by the weighted average of the regression coefficients for a number of years obtained from correlating tobacco yields with soil moisture deficiency index values for irrigated and nonirrigated plots. Expected additional yield due to irrigation was the sum of the products of the estimated yield change for each state of soil moisture deficiency eliminated and the probability of its occurrence. A probability distribution of the soil moisture deficiency index was obtained from the indices computed from weather data recorded at 17 U.S. weather stations in the Coastal Plain of North Carolina over a 25-year period. This method for estimating the expected yield due to irrigation makes it possible to extract information from experiments within a few years, which otherwise could only be obtained by repeating the experiments over a large number of years. The estimate of the expected additional yield due to irrigation alone was 249 pounds per acre.

Costs of irrigation systems were synthesized from engineering data for typical conditions in the Coastal Plain of North Carolina, for 5-, 10-, 25- and 45-acre systems. The expected annual operating cost was evaluated in terms of the expected number of irrigations based on the probability distributions of the soil moisture deficiency index.

To evaluate the total net returns accruing to an investment in irrigation, the annual returns must be discounted. The amount by which returns are to be discounted depends on the sequence of "dry" and "wet" years following the investment in an irrigation system. Returns varied by 15 to 20 percent from an extremely favorable to an extremely unfavorable sequence.

There was a profit from irrigation of tobacco even with the smallest system and the lowest price of tobacco considered in this study, i.e., 5 acres and 40 cents per pound of tobacco. Profit was much higher on farms operating larger systems than on farms with a small number of acres irrigated. With a net price of 50 cents per pound, the annual profit per acre was $39 and $75 for 5- and 45-acre systems. It would take about 5½ years to pay for the 5-acre system and 2½ years to pay for the 45-acre system with typical weather conditions.

Due to economies to scale as the number of acres irrigated increased, the profit from irrigation of additional crops depends also on the other crops to be irrigated on a farm. The effect of the decision to irrigate tobacco on the cost of irrigating an additional crop was analyzed.

Tables and Graphs.

Agr. Expt. Sta., N.C. State Col., Raleigh, N.C.

Schaffner, L. W., Loftsgard, L. D., and Vockrodt, D.C. PRODUCTION AND INCOME VARIABILITY FOR FARM ENTERPRISES ON IRRIGATION AND DRYLAND. N. Dak. Agr. Expt. Sta. B. 445, (Tech.) 31 pp. 1963.

The effects of irrigation on stabilizing income and accumulating capital for dryland farmers who can irrigate a part of their farm acreage were studied in North Dakota. Yields were more stable under irrigation than with dryland farming. For irrigated crops, the coefficient of variation ranged from 14 to 28 percent. For the same crops grown under dryland conditions, the coefficient of variation ranged from 31 to 48 percent.

The coefficient of variation for prices received for crops, livestock, and livestock products ranged from a low of 37 percent to a high of 86 percent. Price of alfalfa had the lowest variability while the price of livestock, particularly beef cows, had the greatest variability.

On the basis of gross income, livestock enterprises were relatively more stable than both irrigated and dryland crop enterprises, and irrigated crop enterprises were less variable than dryland crop enterprises. Net income from irrigated crops was more stable than net income from dryland crops. Irrigated alfalfa had the highest net income and the lowest coefficient of variation of all enterprises compared.

When enterprises were compared on the basis of average return per $100, livestock enterprises had relatively more stable returns but their average returns were somewhat lower than for crop enterprises. Irrigated enterprises were in the intermediate position for stability of income.

Correlation coefficients for returns per $100 of capital outlay for the different enterprises were computed. Crop-livestock combinations were generally more stable in income than crop-crop combinations or livestock-livestock combinations.

The returns per $100 of all costs and correlation data for the different enterprises were combined to show the effects of diversification on income stability at various income levels. Irrigated corn silage combined with the beef cow-calf enterprise showed the highest income stability. Irrigated alfalfa alone showed the highest returns per $100 of all costs. Livestock enterprises stabilized income but lowered the level of total farm income when combined with crops.

Gross income measurements exhibited a greater cyclical pattern than measurements of physical production. Gross income for oats, barley, corn silage, and wild hay on dryland was cyclic in pattern but none of the irrigated crops exhibited cycles in gross income. All livestock enterprises had cycles in gross income. The gross income cycles determined for all enterprises were 3 years or more in duration.

When wheat, oats, barley, corn, and alfalfa grown under irrigation were compared with the same crops grown under dryland conditions, irrigation stabilized income in the following ways: (1) Increased the stability of production by 44 percent; (2) increased the stability of gross income by 14 percent; (3) increased the stability of net income by 18 percent; (4) increased the returns per $100 of all costs by 24 percent; and (5) none of the crops grown under irrigation exhibited cycles in gross income.

Capital accumulation tests indicated that irrigation did not contribute significantly to a faster rate of capital accumulation. If capital was not restricted, however, irrigation contributed to capital accumulation. The higher risk and higher return enterprises accumulated capital at a faster rate than the lower risk and lower return enterprises.

Tables.

Agr. Expt. Sta., N. Dak. State U. Agr. and Appl. Sci., Fargo, N.Dak.

Cooke, F. T., Jr. THE ECONOMICS OF SUPPLEMENTAL IRRIGATION IN COTTON--
YAZOO-MISSISSIPPI DELTA. Miss. Agr. Expt. Sta. B. 669, 28 pp. 1963.

Syphon tube systems were the cheapest method of irrigation studied for the Mississippi Delta. The high per acre cost for sprinkler and gated pipe systems was due to the limited number of acres that could be handled with these systems. The cost of pipe to transport water to irrigated fields was much higher than the cost of a ditch or flume. The necessity of relifting water for these two systems more than doubled the pumping cost of water used. Better planning and engineering could eliminate much of this cost.

Labor costs for syphon tube systems were much less than for the other two systems because no pipe had to be moved and because large acreages were irrigated with one set-up of the system. Most syphon tube systems were used on fields that required little, if any, land forming.

The associated production costs which were brought about by irrigation were not affected materially by the type of distribution system used. Head ditches and flumes used with syphon tubes can interfere with equipment operation, but this usually presented no great problem. The shift from ground machine application to plant application of insecticides was necessary with all irrigation systems.

Most farmers who irrigated applied lay-by chemicals to their irrigated fields.

Irrigated fields were usually cultivated one time less than dryland cotton. One additional hoeing was usually required for weed control.

Cotton yields were increased or decreased by irrigation, depending on how rainfall was distributed during the growing and maturing seasons. Even when yields were increased by irrigation, net returns were sometimes higher on dryland because of the added costs. A much smaller increase in yield was needed to cover the cost of irrigating an acre of cotton with a syphon tube system than with a sprinkler system.

Some farmers consistently made higher yields from irrigation than the average. These farmers were superior managers irrigating better soils.

For irrigation to be profitable in the Delta area of Mississippi, the average farmer must be able to use an irrigation system which has a low development cost and a low operating cost such as sypon tube systems on fairly level fields. If this is not possible, then only exceptional managers who consistently make high cotton yields should consider the practice.

The outlook for irrigation in the area should improve as more farmers become proficient at irrigating and if means can be found to offset some of the bad effects of irrigation in certain years. However, skip row planting could prove to be more profitable to most farmers than irrigation.

Miss. State U., Agr. Expt. Sta., State College, Miss.

Drainage

Lembke, W. D., Delleur, J. W., and Monke, E. J. MODEL STUDY OF FLOW IN STEEP
TILE DRAINS. Trans. ASAE 6: 142-144. 1963.

Gravity flow on steep slopes was studied in 60-foot model drains. The model drains were tested on slopes from 1 to 6 percent with diameters of 3, 4, and 5 inches, with two degrees of roughness, and with discharge rates up to pressure flow.

Five different flow regimes were observed to occur at the transition from part full to full flow. Flow regimes I through IV occurred, while the flow in the drain was being obstructed at the outlet. Flow regime V occurred with a free outlet.

Flow regime III was found to reduce the capacity of the drain. The range of flow rates at which this regime would occur was narrow in field drains because of high roughness.

Application of flow regime V data was limited due to the difference between the model and a field drain, but high negative pressures could develop in a field tile when the flow rate becomes this large.

A table of flow rates at the beginning of flow regime V was presented for common sizes and slopes of tile mains.

S. Dak. State Col., Brookings, S. Dak.

Dylla, A. S., Rollins, M. B., and Myers, V. I. EXPERIMENTAL PLASTIC DRAINS IN NEVADA. Nev. Agr. Expt. Sta. B. 228, 13 pp. 1963.

Experimental plastic drains were installed at a 30-inch depth on three sites near Fallon, Nev. Measurements and observations were carried out for three seasons. Two of the experimental drain installations (Ugalde and Berney sites) appeared moderately successful from the first season of observations. The Newlands Field Station installation failed the first season because the plastic liner either collapsed or filled with sand.

Declining effluent flow rates measured during the second season on the Berney experimental drain indicated tile line closure. Mechanical mousing for line clearance verified this indication.

On the Ugalde site, where the artesian pressure maintained a high water table at all times, three seasons of tile effluent flows and mechanical mousing indicated this installation was failing. This was further verified by visual inspection of excavated sections of the plastic lined drain.

After three seasons of operation, all of the Nevada experimental plastic lined mole drains failed to adequately relieve the high water table. This failure was almost entirely due to collapse of the plastic liner. Wherever the mole drain was constructed in sand or incohesive soils, it was apparent that liner collapse occurred during the first irrigation season. Where the drain was located in cohesive soils, the drain appeared to function properly during the first irrigation season, but drain capacity was reduced greatly during the next two seasons.

Additional studies and field tests are being conducted at other research locations to determine methods and equipment for increasing tile installation depth, maintaining uniform tile grade, and strengthening the plastic liner. If all deficiencies can be corrected and installation costs be kept competitive, plastic-lined drains will definitely have a place in alleviating drainage problems.

Agr. Expt. Sta., Max C. Fleischmann Col. Agr., U. Nev., Reno, Nev.

Schwab, G. O., and Thiel, T. J. HYDROLOGIC CHARACTERISTICS OF TILE AND SURFACE DRAINAGE SYSTEMS WITH GRASS COVER. Trans. ASAE 6: 89-92. 1963.

Replicated drainage plots were established on heavy clay soil near Sandusky Ohio, to evaluate various systems of drainage. These systems included no drainage (level), surface drainage, tile drainage (level), and a combination of tile and surface drainage. A uniform stand of grass was established over the entire experiment. The plots were irrigated twice in 1960 and twice in 1961 to simulate large storms. Tile and surface flow, water-table heights, and soil moisture contents were measured in order to evaluate drainage for these irrigated conditions. Antecedent moisture prior to irrigation was established at different levels. Water was applied by sprinkler irrigation at two rates (0.23 and 0.51 i.p.h.). The results showed that surface drainage reduced tile flow and vice versa. Evaluation of the drainage systems was based on hydrologic measurements rather than on crop response.

Ohio Agr. Expt. Sta., Columbus, Ohio.

Buras, N., and Pillsbury, A. F. LATERAL MOVEMENT OF WATER ALONG A GLASS FIBER SHEET USED AS A DRAINTILE FILTER. Trans. ASAE 6: 173, 176. 1963.

Hydraulic conductivity along a glass fiber sheet sold as a tile filter was tested. The experimental set up was similar to a falling head permeameter. When the flow of water along the glass fiber was assumed to have attained steady state, the hydraulic conductivity of the medium was determined to be in the neighborhood of 4×10^{-1} cm. per second. This value is very close to the hydraulic conductivity of coarse sand and to that of filter material recommended for use in pressure-relief drainage wells.

It appears that the glass fiber sheeting provides for a considerable amount of lateral movement of water toward the openings between the individual sections of drain tile. Under the conditions studied, the material may function much as an envelope in minimizing the need for the streamlines of flow through soil to squeeze in at the joints.

U. Calif., Los Angeles, Calif.

Schenck, H., Jr. SIMULATION OF THE EVOLUTION OF DRAINAGE-BASIN NETWORKS WITH A DIGITAL COMPUTER. J. Geophysical Res. 68: 5739-5745. 1963.

The techniques of Monte-Carlo or random-walk computer simulation, applied with considerable success in nuclear and molecular physics, can also be utilized to generate hypothetical drainage-basin networks. Stream direction within the basin is controlled entirely by random choice, subject only to the constraints that reverse flow and closed loops are not permitted. A program suitable for the IBM 1620 digital computer was described that will generate a rectangular basin of 600 units. Resulting networks were analyzed and the results were compared with field data. The computer-generated networks compared very closely with natural streams as regards stream lengths and numbers of streams of various order. Comparison was also made with Gray's area-length correlation. Although there was considerable scatter in the computer data, Gray's law was roughly predicted by the random-walk models.

Clarkson Col. Tech., Potsdam, N.Y.

Rapp, E. ENGINEERING ASPECTS OF LAND LEVELING. Canada Dept. Agr. P. 1145, 27 pp. 1963.

The steps necessary to complete a land leveling project were given. The information presented will not enable a layman to perform the necessary calculations, but the steps and methods will help engineering technicians to develop and execute a land leveling project. The procedures described were not limited to this area of Canada.

Only the engineering aspects of land leveling were considered. The saving of irrigating labor and the expected increase in production must also be considered and the cost of the leveling justified before the work is undertaken.

Res. Sta., Canada Dept. Agr., Lethbridge, Alberta, Canada.

Brooks, R. H. EVALUATING FLOW MEASURING DEVICES FOR DRAINAGE SYSTEMS. Agr. Engin. 44: 557, 560. 1963.

Three instruments (a pitot-static tube, a midget current meter, and a collapsible 90-deg V-notch weir) were evaluated in a laboratory for accuracy and ease of operation in measuring flow within a drainage tile system.

SWCRD, ARS, USDA, Fort Collins, Colo. 80521

Irwin, R. W. DITCH STORAGE FOR FARM DRAINAGE PUMPING PLANTS. Agr. Engin. 44: 548-549, 551. 1963.

Design and cost factors were established for small farm drainage pumping plants which use a ditch for reservoir and storage.

Ontario Agr. Col., Guelph, Ontario, Canada

Shkinkis, T. N. MOISTURE REGULATION IN SOD-PODZOLIC SOIL BY DRAINAGE. Soviet Soil Sci. 4: 347-351. Apr. 1962.

Moisture regulation in sod-podzolic soils by drainage were studied in Russia. The author concluded that:

1. The moisture regime of sod-podzolic coarse-textured soils changed considerably under the effect of drainage. The maximum moisture content of the soil was higher in nondrained soils than in drained soils. The moisture content of the upper layers of nondrained soils exceeded full moisture capacity for a long period of time, a condition which does not occur in drained soils.
2. The frozen soil layers became enriched with moisture in winter because of the upward movement of water vapor and the capillary rise of water, as well as freezing of water derived from warm spells in winter in the frozen soil layer. This process was more intense in nondrained than in drained soils.
3. The formation and melting of soil ice was accompanied by the movement of the upper soil layers (heaving). Drained soils moved most intensely in their upper 20 cm., and nondrained soils, in their upper 10 cm. The maximum amplitude of the movement was considerably greater in nondrained soil than in drained soils. The root systems of wintering plants were damaged by the more intense movements of the upper soil layers.

4. Soil moisture regulation by means of drainage was of practical importance during the growing period. Spring meltwater drained rapidly in drained soils and field work began one to two weeks earlier than on nondrained soils.

Scripta Technica Inc., 1000 Vermont Ave., N.W. Washington, D.C., 20005

Storage and Conveyance

Bliss, J. H. WATER QUALITY CHANGES IN ELEPHANT BUTTE RESERVOIR. J. Irrig. and Drain. Div., ASCE 89 (IR 3): 53-76. Sept. 1963.

Reservoirs with capacities to hold water from years of surplus supply to those of deficient runoff perform the function of blending both water supplies and the salts dissolved therein, thus producing a more uniform quality of water than that in natural stream discharges. Many reservoirs are constructed in basins of more or less permeable sediments which, by temporary bank storage of water, affect the quality of reservoir releases appreciably.

Weighted annual amounts of each major anion and cation in solution were determined and the amounts of each retained in reservoir storage at the end of every year were computed. Annual gains or losses of each constituent were calculated.

Salt losses during rising reservoir stages were due to temporary bank storage and to actual deposition of some of the less soluble ions, chiefly calcium and bicarbonate in the basin sediments. During falling stages, most of the more soluble ions, sodium, chloride, and sulfate, and a part of the magnesium were returned to the stream, the remainder being deposited from solution.

Salt changes through Elephant Butte were compared with changes, during the same period, resulting from irrigation of 90,000 acres in the valley below. In general, irrigation decreased water quality due to base exchange. Good engineering practice requires that at least as much salt be returned to the stream as is applied on the lands, otherwise irrigated agriculture will eventually be adversely affected.

Base exchange caused a substantial increase in sodium and chloride ions and a continued decrease in calcium, magnesium, and bicarbonate ions in the outflows at the lower end of irrigation. There was also a sulfate loss that did not occur in the passage of water through the reservoir.

The apparent constant relationship between water and dissolved sodium and chloride in its passage through a reservoir suggests a check method of determining changes in a reservoir bank storage.

Construction Engin., Santa Fe, N. Mex.

Hiltibran, R. C. EFFECT OF ENDOTHAL ON AQUATIC PLANTS. Weeds 11: 256-257. 1963.

Disodium endothal was applied to a number of emergent and submerged aquatic species and was found to be particularly effective in controlling pondweeds. On *Potamogeton foliosus*, *P. crispus*, and *P. pectinatus*, liquid and granular preparations appeared to be equally effective. Endothal was not very effective on waterwillow, (*Justicia americana*), and creeping waterprimrose, (*Jussiaea repens* L. var. *glabrescens*), although defoliation did occur.

Aquatic Biol. Sect., Ill. Natural History Survey, Urbana, Ill.

BASIC SOIL SCIENCE

Soil Physics

Leo, M. W. M. EFFECT OF FREEZING AND THAWING ON SOME PHYSICAL PROPERTIES OF SOILS AS RELATED TO TOMATO AND BARLEY PLANTS. Soil Sci. 96: 267-274. 1963.

After freezing and thawing at saturation moisture, the total porosity of eight Canadian soils was decreased and their coefficient of permeabilities was increased at the 5-percent probability level. Between treatments there appeared to be no difference in noncapillary porosity and maximum water-holding capacity of the soils studied.

The influence of freezing and thawing on the soil physical properties was nullified after growth of a crop of tomatoes. There was no difference in the physical properties studied when the undisturbed soil cores were taken from the potted soils where tomato plants had been harvested.

Effects of freezing and thawing of eight Canadian soils as related to growth and production of tomatoes and barley were also studied. The heights and weights of tomato plants and yields of tomato fruits, as well as the effective tillering and grain production of barley, were reduced on the treated soils. The cause of the reduced yields was believed to be due mainly to the impaired physical properties of the soils.

Isotopes Inc., 123 Woodland Ave., Westwood, N. J.

Harris, R. F., Allen, O. N., Chesters, G., and Attoe, O. J. EVALUATION OF MICROBIAL ACTIVITY IN SOIL AGGREGATE STABILIZATION AND DEGRADATION BY THE USE OF ARTIFICIAL AGGREGATES. Soil Sci. Soc. Amer. Proc. 27: 542-545. 1963.

A method for evaluating the mechanisms and factors involved in soil aggregate stabilization by microorganisms was introduced and data presented to illustrate its use. The method involves the incubation of artificial soil aggregates of uniform and controlled physical and chemical properties, so that the effect of one or more variables of soil composition or environment on aggregate stability can be investigated.

The stabilities of differently amended artificial aggregates of two diverse soil materials, incubated for up to 20 weeks, were determined by wet-sieving the dried aggregates. The two soil materials, one obtained from the A_p horizon of a Kewaunee sicl (Gray-Brown Podzolic) and the other from A_1 horizon of a Waupun sil (Brunizem), differed markedly in their contents of clay, nitrogen, and organic carbon.

Microbial gum-amended Kewaunee aggregates possessed a higher initial stability and were more resistant to degradation with continued incubation than corresponding Waupun aggregates. Added nitrogen was associated with accelerated degradation of Kewaunee but not Waupun gum-amended aggregates. Incubated sucrose-amended Kewaunee aggregates showed a slower increase to maximum stability but retained stability longer than sucrose + nitrogen-amended Kewaunee and sucrose- and sucrose + nitrogen-amended Waupun aggregates. Nonamended and nitrogen-amended aggregates of both soils were completely unstable throughout the incubation period. The stability of moist aggregates was a function of wetting rate and moisture status prior to sieving; aggregates moistened slowly to saturation were 100 percent stable to wet-sieving.

Periodate treatment of the aggregates indicated that, with the exception of incubated sucrose-amended Waupun aggregates, "periodate-oxidizable" polysaccharides were important in aggregate stabilization.

Four days of incubation under highly aerobic or anaerobic conditions caused a rapid increase in the stability of sucrose-amended Waupun aggregates. Continued aerobic incubation resulted in a rapid decrease in aggregate stability; aerobically incubated aggregates were totally unstable after 12 days. In contrast, continued anerobic incubation was associated with an increase in stability; 100 percent aggregate stability was reached after 15 days and was still present after 4 weeks. Anaerobically-stabilized aggregates lost their stability completely after 9 days of aerobic incubation.

U. Wis., Madison, Wis.

Acton, C. J., Rennie, D. A., and Paul, E. A. THE RELATIONSHIP OF POLYSACCHARIDES TO SOIL AGGREGATION. Canad. J. Soil Sci. 43: 201-209. 1963.

Studies were conducted on two soil types to determine whether variations in level of aggregation, induced by adding wheat straw, were accompanied by significant changes in the polysaccharide content of the soils.

The addition of finely ground wheat straw to the soils, followed by varying periods of incubation, markedly improved the level of aggregation in both soils. Where nitrogen was added together with the straw, the percentage of aggregates > 0.5 and 0.1 mm. diameter was reduced significantly as compared to the straw treatment alone. Maximal structural improvement due to straw additions were only attained where N was maintained at a relatively low level.

The level of aggregation of the variously treated soils was approximately 35 percent dependent on the 'microbial gum' content of the soil samples. This low level of correlation was due in part to the fact that the maximum level of aggregation was attained at a different sampling period than maximum accumulation of 'microbial gum'. Also, appreciable contents of polysaccharides were found in the humin and humic acid, as well as the fulvic acid fractions of the soil organic matter. It was concluded that level of aggregation is a function, not only of the 'microbial gum' content of the soil, but also of the carbohydrate carbon content of the humic acid-humin fraction.

Pedology Sect., Saskatoon Res. Sta., Canada Dept. Agr., Saskatoon, Saskatchewan, Canada

Siddoway, F. H. EFFECTS OF CROPPING AND TILLAGE METHODS ON DRY AGGREGATE SOIL STRUCTURE. Soil Sci. Soc. Amer. Proc. 27: 452-454. 1963.

Dry aggregate soil structure and relative structural stability were compared for various crop rotations, straw residue placements, and methods of summer fallow tillage under dryland conditions. The proportion of nonerodible aggregates was greater when a straw residue was returned to the soil than when it was burned or partially removed. The increase in aggregation attributed to the residue was higher when the residue was left on the surface than when it was plowed under. The proportion of aggregates > 0.84 mm. in diameter was higher when fallow was initially tilled with the moldboard plow than when it was tilled with a one-way disk or sweep implement. The inclusion of grasses and legumes in rotation with winter wheat and fallow resulted in a lower proportion of nonerodible aggregates than under the more common wheat-fallow rotation.

SWCRD, ARS, USDA, Sidney, Mont., 59270

Willardson, L. S., and Pope, W. L. SEPARATION OF EVAPOTRANSPIRATION AND DEEP PERCOLATION. J. Irrig. and Drain. Div., ASCE 89 (IR 3): 77-88. Sept. 1963.

Unsaturated drainage was shown to be an important factor for consideration in the measurement of consumptive use. Soil moisture depletion was separated into its components of evapotranspiration and deep percolation. This was done from measurements of unsaturated drainage from soil profile and evapotranspiration plus percolation under a normally growing crop.

The magnitude of the unsaturated drainage loss was shown, and the effect on consumptive use rates mentioned. Some areas of practical water use that are affected by unsaturated drainage were noted. Further research was recommended to properly evaluate the influence of initial soil moisture, quantity of water applied for an irrigation, frequency of irrigation, and soil type on unsaturated drainage.

Tables and graphs.

SWCRD, ARS, USDA, Utah State U., Logan, Utah, 84321

Benoit, G. R., and Kirkham, D. THE EFFECT OF SOIL SURFACE CONDITIONS ON EVAPORATION OF SOIL WATER. Soil Sci. Soc. Amer. Proc. 27: 495-498. 1963.

A laboratory study investigating the comparative effectiveness of dust, ground corncob, and gravel mulch in inhibiting the evaporation of soil water from prepared 15-inch long soil cores 3 inches in diameter under various conditions of radiation (0, 200, or 450 ft.-c.) and air movement (0.5 and 7.5 feet per second) showed the gravel mulch to be more effective than either dust or ground corncob mulch. The dust mulch proved to be the least effective. The rate of loss from the mulched cores under conditions of 450 ft.-c. of radiation and air movement of 7.5 feet per second was 0.089, 0.146, and 0.170 g. per hour for the gravel, the corncob, and the dust mulch, respectively. The rate of evaporation from the cores increased with both radiation and air movement levels. By the end of 600 hours, unmulched cores had lost 1.25 to 5 times as much water as had mulched cores.

A concurrent study of the soil moisture distribution that develops with depth as evaporation of soil water proceeds was conducted. The soil moisture distribution in the mulched cores and for the 6- to 15-inch depth of unmulched cores remained essentially constant with depth.

U. Ky., Lexington, Ky.

Gardner, W. R., and Ehlig, C. F. THE INFLUENCE OF SOIL WATER ON TRANSPIRATION BY PLANTS. J. Geophysical Res. 68: 5719-5724. 1963.

A relationship between transpiration and soil suction and soil-water content was derived. Good agreement between the theory and results of laboratory experiments was obtained. The results suggest that once plants wilt, the transpiration rate should be roughly proportional to the available water content of the soil. The lower limit of water available for transpiration occurred at a suction well above 15 bars.

SWCRD, ARS, USDA, Riverside, Calif. 92502

Davis, J. R. RELATIONSHIP OF CAN EVAPORATION TO PAN EVAPORATION AND EVAPOTRANSPIRATION. J. Geophysical Res. 68: 5711-5718. 1963.

A statistical comparison of evaporation from quart cans and a class A Weather Bureau pan for a humid and semiarid area were presented. Correlations of can evaporation with pan evaporation were significant, and correlation with evapotranspiration was as good as that of pan evaporation. The results indicated that small cans merit consideration as a means of estimating evaporation or for scheduling irrigation.

Agr. Res. Cent., Stanford Res. Inst., South Pasadena, Calif.

Atsatt, P. R., and Bliss, L. C. SOME EFFECTS OF EMULSIFIED HEXA-OCTADECANOL ON GERMINATION, ESTABLISHMENT, AND GROWTH OF KENTUCKY BLUEGRASS. Agron. J. 55: 533-537. 1963.

Emulsified hexa-octadecanol was applied to soil surfaces to test the ability of these fatty alcohols to enhance germination, establishment, and growth of Kentucky bluegrass in both greenhouse and field trials.

Saturation of Kentucky bluegrass seed with emulsified TA 16-18 significantly reduced the rate and percent germination. However, increased germination occurred when soil moisture was held at a relatively high level by applying the fatty alcohol to the soil surface containing seed. When large quantities of fatty alcohol were added to the soil, so that the seeds become partially coated, the effect was similar to direct seed treatment with TA 16-18.

A fatty alcohol level between 300 and 500 lb./A. gave the highest dry weight yields in greenhouse tests. In field plots, 450 lb./A. of the emulsion produced the most significant increase in seed germination, percent cover (plant establishment), and subsequent dry weight yields. Powder and flake forms of TA 16-18 had little or a deleterious effect on germination, cover, and dry weight yields.

The quantitative data obtained in field test suggested a greater contrast in stand density than was apparent by casual observation. It was this greater stand density (cover) which resulted in significantly greater dry weight yield, rather than a stimulation in height growth, though the latter was occasionally observed in the greenhouse studies. Further studies are needed to evaluate the cost of materials and labor in relation to the results achieved.

Jr. Author, U. Ill., Urbana, Ill.

Bourget, S. J., and Parups, E. V. GROWTH OF TOBACCO AND SOIL-MOISTURE EVAPORATION AS INFLUENCED BY LONG-CHAIN FATTY ALCOHOLS IN THE SOIL. Soil Sci. 96: 82-85. 1963.

Tobacco plants were grown in the greenhouse in Rubicon s at two different available-moisture levels. The growth of tobacco and the quantity of water used by the plants were significantly reduced when either hexadecanol or docosanol were mixed with the soil at rates of 0.02 and 0.2 percent. Hexadecanol at the rate of 0.2 percent significantly increased the water-use efficiency of tobacco. The water-use efficiency values of tobacco were usually significantly greater at the 0 than at the 50 percent available-moisture level. A laboratory experiment showed that water-evaporation losses from the surface of three soils, treated with long-chain fatty alcohols, were usually significantly lower than those from untreated soils.

Laval U., Quebec, Canada.

Doering, E. J. A DIRECT METHOD FOR MEASURING THE UPWARD FLOW OF WATER FROM THE WATER TABLE. Soil Sci. 96: 191-195. 1963.

A method was described for the direct measurement under field conditions of the vertical flow of water in the vicinity of the water table. The relationship of such measurements to evaporation from fallow surfaces and evapotranspiration from cropped surfaces was discussed. The method is applicable to either homogeneous or stratified soil profiles, and a method for installing the necessary equipment was described. The equipment is simple and inexpensive, requires very little maintenance, and is responsive to small changes in the flow rate.

An evaporation rate of 0.036 ± 0.0024 inch per day was measured for a fallow soil in Imperial County, California. An evapotranspiration rate of 0.146 ± 0.0035 inch per day was measured for a thin stand of morning-glory at the same site. Although this apparatus was read at time intervals in excess of 26 days, flow information can be obtained at weekly, or shorter, time intervals.

U.S. Salinity Lab., SWCRD, ARS, USDA, Riverside, Calif., 92502

Rawlins, S. L., and Gardner, W. H. A TEST OF THE VALIDITY OF THE DIFFUSION EQUATION FOR UNSATURATED FLOW OF SOIL WATER. Soil Sci. Soc. Amer. Proc. 27: 507-511. 1963.

A review of the derivation of the diffusion equation from the potential equation for unsaturated flow of liquids in porous materials revealed that the only additional assumption required was that diffusivity is a unique function of water content. The validity of this assumption was tested by following absorption of water into a horizontal column of soil with a gamma ray densitometer. To ensure that required boundary conditions were met, the soil was evacuated to eliminate entrapped air or air pressure buildup ahead of the wetting-front; and water was applied quickly, evenly, and at constant negative head through a plane sintered glass bead plate, pressed against the bare plane end of the column to initiate flow. Diffusivity vs. water content curves constructed from these data revealed that diffusivity was not a function of water content alone.

U.S. Salinity Lab., SWCRD, ARS, USDA, Riverside, Calif., 92502

Anandakrishnan, M., and Varadarajulu, G. H. LAMINAR AND TURBULENT FLOW OF WATER THROUGH SAND. J. Soil Mech. and Found. Div., ASCE 89 (SM 5): 1-15. Sept. 1963.

The flow of water through sands during turbulence was represented by $v^n = k' i$ in which v is the velocity of flow; i the hydraulic gradient; k', a coefficient of turbulence; and n, a turbulence exponent. Values of n and k' were obtained from a plot of constant head permeability tests on four sands, shown as log-log plot of velocity versus hydraulic gradient. For truly laminar flow, n equaled 1. For sands with $d_{10} > 0.03$ cm., the value of n was greater than 1, indicating turbulent flow. The value of n varied with grain size and hydraulic gradient. A plot of Reynold's number versus Friction Factor showed turbulent flow in one case of sand ($d_{10} = 0.03$ cm.) with Reynold's number substantially less than 1. A method was shown for conducting variable head tests for turbulent flow. The quantity of seepage through sand during turbulent flow can be calculated using the appropriate values of k' and n determined in the laboratory by the procedures outlined.

Indian Inst. Tech., Kanpur, (U. P.), India.

Swartzendruber, D. NON-DARCY BEHAVIOR AND THE FLOW OF WATER IN UNSATURATED SOILS. Soil Sci. Soc. Amer. Proc. 27: 491-495. 1963.

Corresponding values of flow velocity and moisture gradient were calculated for water flow in unsaturated soil, using a graphical analysis of moisture profiles obtained during horizontal absorption of water into air-dry Salkum sicl. Plots of flow velocity vs. moisture gradient were straight lines through the origin at the higher moisture contents, but Darcy proportionality did not hold at the lower moisture contents.

The observed deviations were of the same type found in earlier studies for plots of flow velocity vs. hydraulic gradient for water-saturated materials containing clay, and could be fitted by a modified flow equation developed previously for the water-saturated materials. Physically, the non-Darcy behavior was tentatively attributed to non-Newtonian liquid effects caused by clay-water interaction.

Consideration of diffusion-type analysis from the standpoint of non-Darcy behavior showed that the diffusivity D becomes a function of moisture gradient w as well as moisture content θ. This provided a way of accounting for the nonuniquences of D (θ) recently reported in the literature.

Purdue U., Agr. Expt. Sta., Lafayette, Ind.

Kemper, W. D., and Evans, N. A. MOVEMENT OF WATER AS EFFECTED BY FREE ENERGY AND PRESSURE GRADIENTS III. RESTRICTION OF SOLUTES BY MEMBRANES. Soil Sci. Soc. Amer. Proc. 27: 485-490. 1963.

The validity and method of using the self-diffusion coefficient of water to estimate movement in response to free energy gradients were outlined.

The dominant mechanism of water transport through these membranes was viscous flow, even when osmotic pressure differences were causing the flow. Osmotic pressure and hydraulic pressure differences were equally effective in moving water through a membrane when the solutes were completely restricted by the membrane. When solutes were not completely restricted, osmotic pressure differences were less effective than hydraulic pressure differences in moving water through membranes. Equations including the sizes of the solute molecules and the pores were developed which predict the rate at which osmotic pressure differences move water through uncharged porous media.

SWCRD, ARS, USDA, Fort Collins, Colo., 80521

Reisenauer, A. E. METHODS FOR SOLVING PROBLEMS OF MULTIDIMENSIONAL, PARTIALLY SATURATED STEADY FLOW IN SOILS. J. Geophysical Res. 68: 5725-5733. 1963.

A computer program for solving steady-state Darcian transport of fluid in heterogeneous, partially saturated, porous mediums was described. The program is capable of handling one-, two-, and three-dimensional and axisymmetrical problems with up to 8000 grid points. Instability of the equations and its control were discussed. Solutions of typical problems important in industrial waste disposal, irrigation, and drainage were presented.

Geochemical and Geophysical Res., Hanford Lab., Richland, Wash.

Byrnes, W. R., and Kardos, L. T. HYDROLOGIC CHARACTERISTICS OF THREE SOILS SUPPORTING NATURAL HARDWOODS, PLANTED RED PINE, AND OLD FIELD PLANT COMMUNITIES. Soil Sci. Soc. Amer. Proc. 27: 468-473. 1963.

Hydrologic characteristics of the Hagerstown, Calvin-Edom, and Dekalb soils under natural hardwoods, planted red pine, and old field plant communities were studied during 1958-61. Infiltration of simulated rainfall, water percolation, and soil properties were investigated.

Other than surface organic matter accumulations and rooting habits, there were no significant differences in physical properties of soil profiles under old field and red pine cover. Hardwood soil profiles differed materially from old field and red pine soil profiles, with organic matter, porosity, and water-stable aggregates being higher and bulk density lower in the upper horizons under hardwoods.

Average wet-run infiltration capacity was 33 percent higher under red pine than under old field cover, while infiltration under hardwoods exceeded that under red pine by only 7 percent. Infiltration was less variable under red pine and hardwoods than under old field cover. Vegetational influences affecting water percolation were exerted primarily through their effect on soil porosity. Noncapillary porosity was more closely related to variations in soil permeability than were total porosity or aggregate stability.

Pa. Agr. Expt. Sta., University Park, Pa.

Miller, D. E., and Bunger, W. C. MOISTURE RETENTION BY SOIL WITH COARSE LAYERS IN THE PROFILE. Soil Sci. Soc. Amer. Proc. 27: 586-589. 1963.

The effects of coarse strata on the moisture retention characteristics of soil profiles were evaluated. A sandy loam soil was underlain at various depths by sand or gravel and the moisture status of the soil was observed for 2 months following a heavy irrigation.

The moisture retained by soil underlain by sand or gravel was much greater than in similar depths of a uniform soil. The moisture content of the soil above a layer increased as the layer was approached. The moisture content of the soil underlain by sand or gravel changed very little after the first few days following irrigation whereas in the uniform soil moisture moved downward throughout the observation period.

The moisture retention characteristics of the profiles were roughly estimated from laboratory measurements of unsaturated conductivities of the sand and gravel and from a moisture characteristic curve of the soil.

SWCRD, ARS, USDA, Prosser, Wash., 99350

Dreibelbis, F. R. LAND USE AND SOIL TYPE EFFECTS ON THE SOIL MOISTURE REGIMENT IN LYSIMETERS AND SMALL WATERSHEDS. Soil Sci. Soc. Amer. Proc. 27: 455-460. 1963.

Agronomic practices had a pronounced effect on both the rate and amount of extraction of moisture as determined by studies on the soil moisture regimen in lysimeters and small watersheds. These effects influenced water storage opportunity in the soil profile with its possible influence on infiltration, surface runoff, and percolation. For a second-year meadow in 1960, evapotranspiration from a 72-inch profile amounted to 19.06 and 14.40 inches on improved and prevailing practice, respectively. For corn in 1961, the values on the same areas were 19.81 and 17.90 inches, respectively.

Soil type effects on the moisture regimes were more noticeable in extraction patterns with depth than in the overall water budget. Evapotranspiration from a 72-inch profile in meadow amounted to 19.06 and 19.37 inches on the Keene and Muskingum soils, respectively. The following year (1961), the values in corn were 19.81 and 18.57 on the same areas, respectively.

Both rates and amounts of moisture extraction from a woodland watershed were much greater during the summer and early fall than from pasture. The water needed to recharge the 0- to 72-inch profile to field capacity at the end of the growing season amounted to 6.49 and 5.16 inches on the woodland and pasture watersheds, respectively. Accretion during late fall and winter contributed to water storage so that moisture values on both areas approached equality by spring.

SWCRD, ARS, USDA, Coshocton, Ohio, 43812

Lawless, G. P., MacGillivray, N. A., and Nixon, P. R. SOIL MOISTURE INTERFACE EFFECTS UPON READINGS OF NEUTRON MOISTURE PROBES. Soil Sci. Soc. Amer. Proc. 27: 502-507. 1963.

Measurements of soil moisture by the neutron scattering method were inaccurate when made in the presence of abrupt moisture changes. The effects of air-soil interfaces and of wet-dry soil interfaces were investigated using neutron probes of four different designs. Three of the probes were used to study the effects of wet soil layers within dry soil masses.

Readings taken at shallow depths had the greatest errors. These errors were always negative. Absolute error and depth within the soil to which this effect occurs were related to soil moisture content. Some means of correcting such errors should be used. Errors in determining moisture content of soil zones containing wet-dry interfaces or wet layers were not as serious, and could be neglected in many practical applications. This was especially true when depths reading increments of 6 inches or less were used. These errors were usually negative. Neutron probes tended to underestimate soil moisture content at interfaces or in stratified profiles.

Probe depth reading increments of 1, 3, and 6 inches all gave about the same accuracy of moisture determination. Twelve-inch reading increments gave errors of as much as 6 times greater than those of the smaller increments.

The influence of probe geometry upon neturon meter readings was discussed. When compared on a basis of equivalent source strength, in uniform soils, the probe with end placement of the source was found to be considerably more efficient than the probes with center placement of the source.

SWCRD, ARS, USDA, Lompoc, Calif., 93438

Taylor, H. M., and Gardner, H. R. PENETRATION OF COTTON SEEDLING TAPROOTS AS INFLUENCED BY BULK DENSITY, MOISTURE CONTENT, AND STRENGTH OF SOIL. Soil Sci. 96: 153-156. 1963.

Effects of soil bulk density, moisture content, and soil strength on penetration of cotton seedling taproots were evaluated, using soil cores compressed to 5 different bulk densities and 4 different soil moisture tensions. A correlation coefficient of -0.96 was obtained for the relationship between soil strength (as measured with a penetrometer) and taproot penetration. Although the moisture-content-root-penetration and bulk-density-root penetration relationships were significant, the correlation was much less than that for soil-strength-root-penetration. It was concluded that soil strength--not soil bulk density--was the critical impedance factor controlling root penetration in the sandy soils of the Southern Great Plains.

Southern Great Plains Field Sta., SWCRD, ARS, USDA, Bushland, Tex., 79012

Ayres, A. S., and Doi, M. SOIL TEMPERATURE IN RELATION TO LOSS OF NUTRIENTS BY LEACHING. Soil Sci. 96: 144-148. 1963.

A lysimeter experiment was conducted with a humic ferruginous and a hydrol humic latosol in order to determine the effect of soil temperature on the ability of sugarcane to prevent loss of N and K by leaching. The crop was grown for a period of 3 months without thermal control, following which a soil temperature of 62° F. was established in one series of lysimeters, while in a corresponding set no control was exercised. The soil temperature in the latter set of lysimeters approximated 80° F. Leachates were collected weekly for a period of 7 months following initiation of the temperature differential. Results of the study were summarized as follows: (1) With both soils, loss of N was far higher at 62 than at 80° F. And (2) practically no K was lost from either soil at 80° F. At 62° F., heavy loss of K occurred with one soil but was very moderate with the other. This differential was associated with the base status of the soils, the one from which little K was lost at 62° F. possessing 10 times the base saturation of the other.

Expt. Sta., Hawaiian Sugar Planters' Assoc., Honolulu, Hawaii.

Soil Chemistry and Mineralogy

Moss, P., and Hodnett, G. E. SOME ASPECTS OF THE CATION STATUS OF SOIL MOISTURE. IV: THE RATION LAW APPLIED UNDER FIELD CONDITIONS. Plant and Soil 19: 33-48. 1963.

Assuming the validity of the Ratio Law, a study was made under field conditions of the potassium-intensity status of a mica rich soil as defined by the expression $pK-\frac{1}{2}p(Ca + Mg)$. Soil samples (1-4" and 4-7") were taken every 6 weeks for a period of 14 months from unfertilized and potassium-fertilized plots of an existing 2^5 factorial shade spacing and fertilizer experiment on cacao. Shade was provided by Immortelle trees (*Erythrina peoppigiana*). The soil solutions were extracted and the cations analysed.

Examination of the components, namely pK and $\frac{1}{2}p(Ca + Mg)$ of the term $pK-\frac{1}{2}p(Ca + Mg)$ showed that they were additive in effect and that the component pK was more dominant, $\frac{1}{2}p(Ca + Mg)$ being a minor correcting component. Thus the potassium-intensity status could be represented by either the term pK or $pK-\frac{1}{2}p(Ca + Mg)$, the latter being slightly more precise.

In the unfertilized plots in the absence of shade, values of $pK-\frac{1}{2}p(Ca + Mg)$ were substantially constant within the wet and dry seasons, implying that the soil/soil-solution equilibrium remained relatively undisturbed. The values were significantly different for both soil depths; the dry-season values being higher. There was some indication of a similar effect in the presence of shade. Under shade there was a significant change in the potassium-intensity status with depth in both seasons.

In the potassium-fertilized plots in the presence or absence of shade, the values of $pK-\frac{1}{2}p(Ca + Mg)$ were substantially constant throughout both seasons, the values were higher for the shaded plots than for the unshaded plots. As for the unfertilized plots, there was a significant difference between values for each of the depths. The presence of shade had no significant effect on the difference between depths. In the presence or absence of shade the effect of potassium-fertilizer was similar for both depths.

The effects of weathering of primary minerals, organic-matter mineralization, potassium fixation, vegetative uptake, and leaching were discussed. The principal factor reducing the potassium-intensity status of the unfertilized plots was probably the potassium fixation that occurred during the transition from wet to dry periods. Substantial constancy of potassium-intensity status during the dry period was probably due to a balance being established between the effects of potassium release by weathering and organic-matter mineralization on the one hand and potassium removal by fixation and vegetative uptake on the other hand. The transition from the dry to the wet period was thought to involve the release of fixed potassium, while during the wet period the substantial constancy of the potassium-intensity was probably due to the balance between weathering, organic-matter mineralization, and defixation on the one hand and vegetative uptake and leaching on the other. In contrast to the unfertilized plots, it was suggested that due to the lower fixing power of potassium-fertilized plots, the small counter-balancing effects of weathering and organic-matter mineralization versus vegetative uptake and fixation maintained a substantially constant potassium-intensity status during the transition from the wet to the dry period. The transition from the dry to the wet period of the potassium-fertilized plots involved only small effects which tended to maintain the constancy of the potassium-intensity status. The effects during the dry and wet periods behaved similarly for unfertilized and potassium-fertilized plots.

U. West Indies, Imperial Col. Trop. Agr., Trinidad, West Indies.

Vose, P. B. THE CATION CONTENT OF PERENNIAL RYEGRASS (LOLIUM PERENNE L.) IN RELATION TO INTRASPECIFIC VARIABILITY AND NITROGEN/POTASSIUM INTERACTION. Plant and Soil 19: 49-64. 1963.

Certain varieties of perennial ryegrass tend to have a consistently high potassium content, while others are consistently low, these differences are reflected in the K/Ca + Mg ratio. For material grown in soil, the ratio was greatest in the acid soil and least in the soil of pH 7.2. The K/Ca +Mg ratio in the grasses reflected the K/Ca + Mg ratio in the three soils. Variation in ratio between varieties on the acid soil covered the range from 1.55 for Hunsballe to 2.75 for Kent.

Total cation content and potassium content were highly correlated ($r > +0.80$) with cation-exchange capacity. It was suggested that some regulator other than CEC and Donnan distribution laws must be postulated for the selective assimilation of monovalent and divalent cations by varieties of a species grouped within a relatively narrow range of CEC.

The possibility was advanced of selecting ryegrass varieties for different content of potassium.

The interaction of potassium and nitrogen showed that potassium, at the levels employed, had no effect on yield or tiller number, although there were significant differences due to nitrogen level.

At the lower nitrogen level, the nitrogen content of both foliage and roots was unaffected by potassium, but with high nitrogen there was an increase in nitrogen content of the foliage with decrease in potassium nutrition. Concurrently the nitrogen content of the root decreased.

Potassium content of both foliage and roots showed extreme variability with nutrient potassium. At the highest nitrogen level, the potassium content of the foliage varied between 2 and 8 percent for foliage yields that were not significantly different. On the highest potassium level, the potassium content of the foliage decreased with reduction of nitrogen nutrition, but with low potassium the potassium content increased with decreasing nitrogen. The potassium content of the roots showed similar but even more marked trends.

Comparison of potassium levels within nitrogen treatments showed that the calcium content of the foliage increased with decreasing potassium. Sodium content was inversely related to potassium.

The magnesium content of the foliage was highest at the lowest nitrogen level, while the magnesium content of the roots was greatest with high nitrogen. It was concluded that increasing potassium nutrition does not necessarily lead to a reduction in foliage magnesium content.

Col. Agr., Seoul National U., Suwon, Korea.

Graham-Bryce, I. J. SELF-DIFFUSION OF IONS IN SOIL: I. CATIONS. J. Soil Sci. 14: 188-194. 1963.

Self-diffusion coefficients for Rb^+, K^+, and Sr^{++} were measured in homoionic soils by determining the quantities of radioactive tracers crossing from labelled to initially unlabelled soil sections through ion-exchange membrane barriers. Diffusion coefficients were considerably lower than in aqueous solution, and the value for Sr^{++} was approximately one-tenth of those for the monovalent ions.

The diffusion of Rb^+ in soils containing both Rb^+ and Ca^{++} was also studied using various compactions and soil solution compositions. The results suggest that cations are able to diffuse along the charged surfaces of soil particles, but at a lower rate than in the free pore solution.

Experiments on the effects of temperature suggest that the activation energy for the diffusion of Rb^+ in the heteroionic soil was greater at low than at high bulk densities, a result which was interpreted in terms of surface movement.

U. Col. North Wales, Bangor, Caernarvon, Wales.

Graham-Bryce, I. J. SELF-DIFFUSION OF IONS IN SOIL: II. ANIONS. J. Soil Sci. 14: 195-200. 1963.

Self-diffusion coefficients for I^- and $H_2PO_4^-$ in soils were measured by determining the movement of radioactive tracers of these ions from a cylindrical section of labelled soil to a similar section initially without tracer. D_1 varied with the composition of the equilibrium soil solution used, both concentration and nature of cation affecting the value. These results may be explained by variations in the extent of negative adsorption of diffusing anions in the presence of negatively charged soil particles, and the consequent variation in the size of pore from which the anions were excluded.

Phosphate diffusion was measured in the natural soil. The low values of D_{H2PO4} were attributed to adsorption and fixation of phosphate ions. Results obtained using different methods of phosphorus extraction and treatments designed to investigate effects of microbial activity were discussed.

U. Col. North Wales, Bangor, Caernarvon, Wales.

Helmy, A. K. CALCULATION OF NEGATIVE AND POSITIVE ADSORPTION IN SOME CLAY ELECTROLYTE SYSTEMS. J. Soil Sci. 14: 217-224. 1963.

Calculations were presented of the fraction of charge compensated by cations for some clay systems. Surface charge density, electrolyte type, concentration, and composition were studied in their relation to positive adsorption and exchange of cations in some clay systems.

It was calculated that the negative adsorption due to mono-valent anions was about one-third that due to divalent ones present at the same concentration.

Alexandria U., Alexandria, Egypt.

Le Roux, F. H., Cady, J. G., and Coleman, N. T. MINERALOGY OF SOIL SEPARATES AND ALKALI-ION EXCHANGE-SORPTION. Soil Sci. Soc. Amer. Proc. 27: 534-538. 1963.

X-ray and petrographic examination of a number of California soils derived from granite-diorite sedimentary material showed the presence of biotite weathering products which appeared to include slightly altered biotite, vermiculite, and a regularly interstratified biotite-vermiculite. Magnetic and specific gravity separations of fine sand- and silt-size material from a Hanford soil yielded relatively pure minerals giving rational series of X-ray reflections from 25, 14.48, or 10Å. spacings when Mg-saturated; 23.5, 12.25, or 10Å, when Na-saturated; and 10Å. when K-saturated. Cation-exchange capacities of vermiculite, hydrobiotite, and biotite separated from 100-to 200-mesh material were 0.95, 0.40, and 0.15 me. per g., respectively. Tagged rubidium sorbed on exchange sites was displaced by 0.1N NaCl to the extent of 10 percent from vermiculite, 20 percent from hydrobiotite, and 42 percent from biotite fractions. Soil vermiculite and hydrobiotite had smaller cation-exchange capacities than similar separates from the Libby, Montana, vermiculite deposit, and the reversibility of the Rb-sorption reaction was less for the soil minerals.

Vermiculite-hydrobiotite-biotite appeared to be the predominant clay mineral in all size fractions from the Hanford soil except the $< 0.5\mu$ clay. Cation-exchange capacities of coarse clay and silt were relatively large (0.35 to 0.0067 me. per g.) and sorbed Rb was only around 50 percent exchanged by 0.1N NaCl. Rubidium could be almost completely displaced from $< 0.5\mu$ clay. It was concluded that vermiculite and hydrobiotite in the coarse clay, silt, and fine sand fractions accounted for around 40 percent of the cation-exchange capacity of the soil for essentially all of its capacity to sorb Rb or K irreversibly.

U. Calif. Citrus Res. Cent., Agr. Expt. Sta., Riverside, Calif.

DeMumbrum, L. E. CONVERSION OF MICA TO VERMICULITE BY POTASSIUM REMOVAL. Soil Sci. 96: 275-276. 1963.

Rapid conversion of the micas--muscovite, phlogopite, and biotite--to vermiculite was demonstrated as a result of rapid potassium removal from the minerals by relatively brief contact periods with sodium tetraphenylboron. Changes in basal spacings were followed by X-ray diffraction. This rapid laboratory procedure simulates the geologic and soil phenomenon of mica weathering, and shows the relationship of the vermiculite to the parent micas. The relative X-ray diffraction intensities of micas, vermiculites, and interstratified minerals have been reported as measures of degrees of potassium removals and of conversion of micas to vermiculites. The possibility of conversion of chlorite to a micaceous mineral by Mg removal was also discussed.

Howardstown, Ky.

Johnson, L. J., Matelski, R. P., and Engle, C. F. CLAY MINERAL CHARACTERIZATION OF MODAL SOIL PROFILES IN SEVERAL PENNSYLVANIA COUNTIES. Soil Sci. Soc. Amer. Proc. 27: 568-572. 1963.

As part of the detailed soil survey of Pennsylvania, clay mineral types in modal soil profiles were identified to determine: (1) Weathering trends within profiles; (2) the distribution of clay types; and (3) the utility of clay mineral data for soil correlation.

The clay mineral data were summarized on triangular diagrams which graphically illustrated the distribution of clay mineral types among horizons within a profile and between profiles of the same soil type. Differences in distribution of clay types between profiles of the same type were very common. The major change with increasing depth within the profiles studied was the increase in illite and the decrease in vermiculite and/or aluminum interlayered vermiculite. Kaolin minerals were relatively constant with increasing depth. Montmorillonite was generally associated with poor drainage and high organic matter content.

It was concluded that soil correlation with clay mineral data was helpful but only of restricted application. Weathering was manifested by the sequence illite to vermiculite to aluminum interlayered vermiculite. Parent material controlled the occurrence of kaolin and trioctahedral chlorite.

Pa. Agr. Expt. Sta., University Park, Pa.

MacKenzie, A. F., and Campbell, C. A. THE INFLUENCE OF THE META-STABLE TRIPLE POINT SOLUTION OF MONOCALCIUM PHOSPHATE MONOHYDRATE UPON THE CLAY SEPARATES OF TWO ONTARIO SOILS. Canad. J. Soil Sci. 43: 260-267. 1963.

Samples of material less than 2μ in diameter were obtained from the surface horizon of a Guelph l and of a Haldimand cl. These samples were subjected to six successive treatments with the meta-stable triple point solution of monocalcium phosphate monohydrate (MTPS) to simulate the environment near a dissolving superphosphate granule. Samples of montmorillonite and illite standard clays were included. The dissolution losses in percent were: Guelph c 59.5, Haldimand c 40.4, montmorillonite 3.4, and illite 8.1. Total chemical analyses, X-ray diffraction techniques, differential thermal analyses, and electron microscope observations were used to determine the nature of these losses and the results were given in tables, photographs, and graphs. In the soil clay separates, vermiculite and interstratified montmorillonite were more susceptible to the action of MTPS than were the illite or halloysite clay minerals. As a result of the MTPS treatment there was a decrease in aluminum, iron, and potassium, but an increase in the percentage of silica. There were several indications of the destruction of clay minerals, as well as the removal of amorphous material.

Macdonald Col. of McGill U., Macdonald College, Quebec, Canada.

Harding, R. B., Embleton, T. W., Jones, W. W., and Ryan, T. M. LEACHING AND GASEOUS LOSSES OF NITROGEN FROM SOME NONTILLED CALIFORNIA SOILS. Agron. J. 55: 515-518. 1963.

Leaching and volatile losses of N were studied in some California nontilled soils. Various nitrogenous fertilizers were broadcast, but not incorporated, on a mature southern California citrus orchard irrigated with sprinklers. Manure, urea, and $Ca(NO_3)_2$ were studied for a 2-year period when applied to an acid, well-drained soil. Manure was an inefficient source of N, and low recovery rates of NO_3-N were obtained. Urea, while more efficient than manure, also had relatively low recovery rates of applied N, and substantial losses of N by NH_3 volatilization were suggested from the results obtained. There was little carryover from year to year of soil NO_3 from any of the N sources applied, indicating substantial leaching losses of N. Fertilizer practices which resulted in high soil NO_3 levels during September appear to be most conductive to reported poor fruit quality from N fertilization of Valencia oranges.

Comparative studies of NH_3 volatile losses from surface-broadcast $(NH_4)_2SO_4$, NH_4NO_3, urea, and urea-formaldehyde were made in outdoor experiments. Rates of application were 400 pounds of N per acre. Percentage losses of applied N as NH_3 of 13.2, 7.8, 1.3, and 1.0 were obtained for urea, $(NH_4)_2SO_4$, NH_4, NO_3, and urea-formaldehyde, respectively, during a 2-week experimental period from a slightly calcareous Sorrento sil. A percentage loss of 12.5 of applied N as NH_3 was obtained for urea broadcast on a slightly acid Romona sl during a 2-week period.

U. Calif. Citrus Res. Cent., Agr. Expt. Sta., Riverside, Calif.

Cairns, R. R. NITROGEN MINERALIZATION IN SOLONETZIC SOIL SAMPLES AND SOME INFLUENCING FACTORS. Canad. J. Soil Sci. 43: 387-392. 1963.

Samples of an alkali Solonetz and a Solodic soil that occurred in close proximity in the field were studied to determine if factors other than the quantity of nitrogen might be responsible for the difference in the ability of the two soils to provide nitrogen to crops. The effect of altering the C/N ratio, heating, and the addition of nitrogenous compounds on nitrogen mineralization and CO_2 evolution from A horizon samples were studied.

Added sucrose stimulated the evolution of CO_2 in the alkali Solonetz samples, but added ammonium sulphate had no appreciable effect on the evolution of CO_2. Heat caused a direct release of ammonium-nitrogen even from air-dry samples, and preheating caused a marked increase in ammonification during subsequent incubation. Both ammonification and nitrification took place quite effectively in samples of the alkali Solonetz soil to which a relatively simple organic nitrogen compound was added.

The factor limiting nitrogen mineralization in alkali Solonetz soil appears to be the lack of readily decomposable organic nitrogen compounds.

Canada Dept. Agr., Vegreville, Alberta, Canada.

Soper, R. J., and Huang, P. M. THE EFFECT OF NITRATE NITROGEN IN THE SOIL PROFILE ON THE RESPONSE OF BARLEY TO FERTILIZER NITROGEN. Canad. J. Soil Sci. 43: 350-358. 1963.

Barley was shown to have a variable response to fertilizer nitrogen in nine field trials on non-fallow land. A large part of this variability was accounted for by differences in the nitrate nitrogen content of the soil profile at seeding time.

Nitrate nitrogen accumulated in non-fallow soil profiles in large amounts and this nitrogen influenced the uptake of nitrogen by barley to the same extent as nitrogen added as fertilizer.

Various tests for "available" nitrogen were used and the nitrate nitrogen content of the soil to a depth of 4 feet gave the best correlation ($r = 0.95$) with yield response to nitrogen.

U. Manitoba, Winnipeg, Manitoba, Canada.

Terent'Yeva, N. L. DYNAMICS OF THE TOTAL NITROGEN CONTENT IN SOIL UNDER PINE PLANTATIONS ON OLESHKOV SANDS. Soviet Soil Sci. 1: 34-39. Jan. 1963.

The slightly humified sandy (pine forest) soils of the lower Dnepr area in Russia being reforested are characterized by a great change of the seasonal total nitrogen content in them.

The maximum amount of total nitrogen was found in the spring, from March to early June. The amount of nitrogen in the upper 0.50 m. varied from 0.5-1.5 metric tons/ha. Up to 80 percent of the nitrogen was lost from the soil during the hot summer months. Total nitrogen returned to its initial level in late autumn and in the spring of the following year.

The temporary summer loss of nitrogen from sandy soil occurred in the forest and in areas bare of vegetation.

The summer loss of nitrogen in dry steppe sands was attributable to the intense ammonification of organic nitrogen in the spring. The ammonia thus formed changed to a gas and volatilized from the soil when they dried out during the hot months.

The volatilization of ammonia was promoted by the almost complete absence of an adsorption complex in sands, which would be able to bind gaseous ammonia.

The subsequent restoration of total nitrogen in the Oleshkov sands apparently resulted from the biological fixation of atmospheric nitrogen.

The temporary loss of nitrogen from the soil, which coincided with the growing period of pine, created a critical situation in the nutrient regime of young plantations. This nutrition deficit was doubled by the systematic removal of fallen needles and forest litter. Nitrogen losses in the form of gaseous ammonia decreased considerably in moist soil.

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MacLean, A. A., and Doyle, J. J. THE EVALUATION OF THE RESIDUAL EFFECT OF FERTILIZER IN LONG-TERM FERTILITY PLOTS. I. POTASSIUM. Canad. J. Soil Sci. 43: 229-234. 1963.

Residual effects of long-term annual applications of fertilizer potassium on the potassium status of an acid sandy loam Podzol were investigated in a greenhouse experiment. Potassium accumulated in the surface soil in a form readily available to plants.

On plots with higher cation exchange capacities, resulting from manurial treatments, there was no evidence to indicate leaching below 15 inches. On plots where cation exchange capacity was not increased by treatment, a higher percentage potassium saturation at greater depths indicated that leaching of potassium had occurred to a depth of 21 inches. An increased concentration of nitric acid-soluble potassium at greater depths suggested that some of the leached potassium had been converted to the non-exchangeable form.

Accumulation in the surface soil was sufficient to supply most of the potassium requirement of ladino clover under conditions of intensive cropping. The results suggested that exchangeable and nitric acid-soluble potassium were reliable criteria of available potassium.

Canada Dept. Agr., Fredericton, New Brunswick, Canada.

Dowdy, R. H., and Hutcheson, T. B., Jr. EFFECT OF EXCHANGEABLE POTASSIUM LEVEL AND DRYING UPON AVAILABILITY OF POTASSIUM TO PLANTS. Soil Sci. Soc. Amer. Proc. 27: 521-523. 1963.

In successive croppings of Sudangrass, K uptake by plants was greater from soil samples that released K upon drying than from comparable continuously moist samples. For soils originally low in exchangeable K, more K was released from continuously moist samples than from similar samples which had been air-dried prior to cropping. This was considered a response to increased stress by the plants upon the K equilibrium, because of less readily available K in the continuously moist samples.

Potassium uptake data, reductions in exchangeable K levels, and K-release patterns strongly suggested that added K fixed by drying was available for plant use. Crop yields were the same for both moist and air-dried soil samples at high levels of exchangeable K; but, yield data did reflect K released by drying samples initially low in exchangeable K.

Jr. Author, U. Ky., Lexington, Ky.

Levesque, M., and Ketcheson, J. W. THE INFLUENCE OF VARIETY, SOIL TEMPERATURE, AND PHOSPHORUS FERTILIZER ON YIELD AND PHOSPHORUS UPTAKE BY ALFALFA. Canad. J. Plant Sci. 43: 355-360. 1963.

Du Puits and Ladak varieties of alfalfa were grown for 10 weeks in the greenhouse on soil-sand media controlled at temperatures of 10°, 18°, and 26° C. P-32-tagged superphosphate was applied at rates of 10 and 80 p.p.m. phosphorus, respectively. Dry matter yields and phosphorus content of the tissue was determined at the end of the growth period.

Increasing soil temperature from 10° to 26° C. caused corresponding increases in total phosphorus uptake as a result of an increase in dry matter yields as well as an increase in the percentage of phosphorus in the plant tissue. Ladak exhibited the higher yield potential although Du Puits was less affected by low soil temperature conditions and appeared capable of making better use of soil phosphorus. With the higher phosphorus application, the root-top ratio for Du Puits was greater than that for Ladak, and the maximum value for this ratio occurred at 18° C. for each variety. P-32 activity measured in the tissue indicated that soil temperature was critical in terms of phosphorus fertilization in the 4- and 6-week stages of growth.

Expt. Farms, Karuskasing, Ontario, Canada.

Fuller, W. H., Tucker, T. C., Carpenter, E. W., and Abbott, J. L. ABSORPTION OF PHOSPHORUS BY COTTON FROM FERTILIZERS OF DIFFERENT PHOSPHORUS WATER SOLUBILITIES AS RELATED TO STAGE OF PLANT GROWTH AT THE TIME OF APPLICATION. Soil Sci. Soc. Amer. Proc. 27: 397-401. 1963.

The absorption of P by cotton from two radio-active nitric phosphate fertilizers of about 17 and 44 percent water-soluble P and aqueous solution of H_3PO_4 fortified with NH_4NO_3 to give an N/P ratio equal to the two 20-20-0 nitric phosphates was studied in a field experiment at rates of 0, 20, and 60 pounds P per acre on a calcareous soil. Applications of the fertilizers were drilled 6 inches deep and 6 inches to the side of the row at three different stages of plant growth to relate absorption of P with different growth stages.

More P was derived from the fertilizer at the 60-pound rate than the 20-pound rate of application. At least as much or more P was absorbed from the nitric phosphates of 17 and 44 percent water-soluble P as from the 100 percent watersoluble P of H_3PO_4 applied in aqueous solution when they were applied in April and June. When the same materials were applied on July 19, less P was absorbed from the nitric phosphates than the wholly soluble aqueous H_3PO_4 fertilizer. The relative effectiveness of the nitric phosphates was greatest for the early application and decreased with the subsequent later applications.

U. Ariz., Tucson, Ariz.

Pratt, P. F. ORGANIC PHOSPHORUS IN SOME LACUSTRINE AND ALLUVIAL SOILS OF CALIFORNIA. Soil Sci. 96: 289-291. 1963.

Organic C and organic P data for a group of lacustrine and a group of alluvial soils were presented and discussed. Lacustrine soils, irrespective of their organic C content, had higher ratios of organic C to organic P than alluvial soils. Within each group of soils, the ratios were not significantly correlated with organic C content. Suggested causes of the higher ratios of organic C to organic P in lacustrine soils were that the native vegetation had a lower organic P content, and the organic P was less a product of microbial synthesis in lacustrine soils than in alluvial soils.

U. Calif. Citrus Res. Cent., Agr. Expt. Sta., Riverside, Calif.

Bingham, F. T. RELATION BETWEEN PHOSPHORUS AND MICRONUTRIENTS IN PLANTS. Soil Sci. Soc. Amer. Proc. 27: 389-391. 1963.

Sand culture experiments were conducted to evaluate the role of the plant and phosphorus substrate concentration in the possible phosphorus-induced changes in micronutrient availabilities. Beans, corn, tomatoes, and sour orange seedlings were grown 6 weeks or more under controlled sand culture conditions with P concentrations being maintained at 1 p.p.m. P, 10 p.p.m. P, and 100 p.p.m. P. The micronutrients were uniformly added to all P solutions in amounts calculated to produce concentrations of 0.25 p.p.m. of B and Mn, and 0.05 p.p.m. of Cu, Mo, and Zn. Iron, as magnetic, was incorporated with the sand.

No P-induced Zn or Cu deficiency occurred in any of the plants tested. In case of citrus, the levels of Zn within the plant actually increased with increasing substrate P. Of all plants tested for possible P-Cu antagonisms, only citrus exhibited a reduction in Cu uptake. Boron, Fe, Mn, and Mo were similarly studied. High P substrate concentrations may restrict the movement of Mo and Fe in some plants. Variable results were noted for B and Mn.

Regarding mechanisms of P-induced Zn or Cu deficiency, the experiments suggest that the plant is not exclusively involved; reactions occurring outside of the physiologically active root contribute to the induced deficiency.

U. Calif., Riverside, Calif.

Williams, R. J. B., Cooke, G. W., and Widdowson, F. V. RESULTS OF AN EXPERIMENT AT ROTHAMSTED TESTING FARMYARD MANURE AND N, P, AND K FERTILIZERS ON FIVE ARABLE CROPS: II. NUTRIENTS REMOVED BY CROPS. J. Agr. Sci. 60: 353-357. 1963.

The amounts of N, P, and K recovered by five arable crops and by permanent grass from soil alone, and from fertilizer and farmyard manure (FYM) dressings were measured. All the crops responded well to P and K fertilizers and all except clover responded to N. Uptakes from soil alone were, therefore, the maximum amounts of each nutrient that each crop could remove when supplied with other fertilizer nutrients (the exchangeable Ca and Mg in the soil were adequate).

Permanent grass (free from legumes) obtained about 114 lb. N/A. each year from soil and other natural sources; winter wheat obtained 100 lb. N, kale and potatoes about 80 lb. N, and spring barley only 57 lb. A 1-year ley of clover and grass fixed at least 100 lbs. N/A./year. Permanent grass removed most P from soil (17 lb./A./year), potatoes removed least (6 lb. of P) and other crops intermediate amounts. Most K was taken from soil by kale (70 lb. K/A./year) and least (20 lb.) by potatoes. Annual variations in the amounts of nutrients recovered from soil by any one crop were much greater with K than with N or P.

Most fertilizer N was recovered by kale and least by potatoes; with these crops two-thirds and one-third, respectively, of the light dressing was recovered, percentage recovery from the higher rate of N tested was less. Kale and the 1-year ley recovered nearly one-quarter of the P applied, permanent grass recovered little more than one-tenth. Clover-grass ley recovered most fertilizer K, apparently taking up four-fifths of that applied. Potatoes, kale, and permanent grass all recovered more than half of the fertilizer K given, cereals were least efficient although both responded well to K dressings.

Farmyard manure supplied large amounts of nutrients to all crops. Similar amounts of N, P, and K appeared to be recovered from FYM whether or not NPK fertilizer was also used. A rough estimate was that crops like kale, potatoes, and permanent grass, which received FYM each year, recovered about 30 lb. of N, 4 lb. of P, and 75 lb. of K from a 10 tons/A. dressing.

Rothamsted Expt. Sta., Harpenden, Hertfordshire, England.

Schnitzer, M., and Skinner, S. I. M. ORGANO-METALLIC INTERACTIONS IN SOILS: I. REACTIONS BETWEEN A NUMBER OF METAL IONS AND THE ORGANIC MATTER OF A PODZOL B_h HORIZON. Soil Sci. 96: 86-93. 1963.

Reactions between organic matter (O.M.) extracted from a podzol B_h horizon, and the metal ions Fe^{+++}, Al^{+++}, Ca^{++}, Mg^{++}, Cu^{++}, and Ni^{++} were investigated by potentiometric and conductometric titrations, absorption, and infrared spectroscopy and flocculation experiments.

The O.M. formed stable water-soluble complexes with all of the metals over the pH range usually encountered in podzol soils. With the aid of the known molecular weight of the O.M., the weight ratios at which metals and O.M. combined were expressed in terms of molar ratios. Ferric iron, aluminum, and copper formed water-soluble 1:1 molar complexes with O.M. at approximately pH 3, while 2:1 molar water-soluble complexes were formed at pH 5. Indications were also obtained of the formation of water-insoluble 6:1 molar complexes between ferric iron, aluminum, and O.M., involving in each instance one COOH group per atom of metal. These experiments suggest the formation of a range of molar complexes, varying from 1:1 to 6:1 and becoming increasingly water-insoluble as more metal is complexed.

The formation of electrovalent bonds between negatively charged carboxyl groups of the O.M. and positively charged partially hydroxylated iron and aluminum compounds was noted. No clear indication concerning the participation of phenolic hydroxyl groups in the organo-metallic reactions was obtained.

Soil Res. Inst., Ottawa, Alberta, Canada.

Schnitzer, M., and Skinner, S. I. M. ORGANO-METALLIC INTERACTIONS IN SOILS: II. REACTIONS BETWEEN DIFFERENT FORMS OF IRON AND ALUMINUM AND THE ORGANIC MATTER OF A PODZOL B_h HORIZON. Soil Sci. 96: 181-186. 1963.

The uptake by organic matter (O.M.) of iron and aluminum from hydrous oxides and metal-enriched exchange resins, and from a soil material under a variety of conditions, such as might be encountered in podzol profiles, was investigated.

On continuous wetting and leaching in a perfusion apparatus, in 1 week 1.0 mole of O.M. mobilized 1.0 mole of iron from goethite and an iron-saturated exchange resin, and 1.1 mole of aluminum from aluminum-saturated exchange resin. Metal uptake on standing and shaking, and on intermittent leaching, was considerably lower.

The effect of pH was difficult to estimate. In the perfusion experiments it had no effect. In reactions with goethite and gibbsite, metal uptake decreased with increase in pH, whereas the opposite was essentially true when O.M. reacted with soil material.

Atmosphere (air vs. nitrogen) had no apparent effect on iron uptake by O.M.

Methylation of most of the active acid groups reduced iron uptake to very low values, thus demonstrating the important role of carboxyl groups in the organo-metallic reactions.

Soil Res. Inst., Ottawa, Alberta, Canada.

Reisenauer, H. M. THE EFFECT OF SULFUR ON THE ABSORPTION AND UTILIZATION OF MOLYBDENUM BY PEAS. Soil Sci. Soc. Amer. Proc. 27: 553-555. 1963.

An experiment including a factorial combination of 4 rates of S and 3 rates of Mo fertilization was conducted on a low-S, low-Mo soil (Palouse sil) to evaluate the effects of soil S level on the absorption and utilization of Mo by peas.

The uptake of soil and fertilizer Mo was markedly reduced by applications of sulfate fertilizer. The higher rates of S fertilization also reduced the apparent efficiency of utilization of Mo by the plant. Higher plant Mo levels were required for maximum yield and N fixation as the SO_4-S content of the plant tissue was increased by S fertilization. Correlation coefficients of 0.78 and 0.94 were obtained with response surface equations for seed yield and vine N content as functions of the Mo and SO_4-S contents of the plant tissues. Maximum pea yields were associated with plant tissue Mo contents of 0.3 to 1.0 p.p.m. and SO_4-S content of 200 to 600 p.p.m.

Wash. State U., Pullman, Wash.

McEvoy, E. T. INFLUENCE OF CULTURE SOLUTION TEMPERATURE ON UPTAKE OF RADIOCALCIUM BY FLUE-CURED TOBACCO. Canad. J. Plant Sci. 43: 447-450. 1963.

Ca-45 uptake by flue-cured tobacco increased significantly with increase in root temperature from 20° to 30° C. during a 6-day absorption period. A further temperature increase to 35° C. resulted in a non-significant difference in Ca-45 uptake. The increase in Ca-45 uptake with increasing temperature was not related to increase in root growth during the absorption period.

Plant Res. Inst., Res. Br., Canada Dept. Agr., Ottawa, Ontario, Canada.

Mattingly, G. E. G. RESIDUAL VALUE OF SUPERPHOSPHATE AND ROCK PHOSPHATE ON AN ACID SOIL: II. SOIL ANALYSIS AND GREENHOUSE EXPERIMENTS. J. Agr. Sci. 60: 409-414. 1963.

Soil analyses and a greenhouse experiment on soils taken from a field experiment to estimate residual values of phosphates were used to show changes in the amount and distribution of residual phosphate in the soil.

Total and $NaHCO_3$-soluble P were large in the top 0-3 in. of soil after applying superphosphate. Total P was large, but $NaHCO_3$-soluble P much less, where rock phosphate had been applied in the field. Plowing distributed total and $NaHCO_3$-soluble P more uniformly through the 0-6 in. layer of soil.

Soil analysis and crop yields in the greenhouse showed that the residual value of equal amounts of P_2O_5 as rock phosphate and superphosphate, 3 years after application, were very similar.

At the end of the field experiment, the sand fraction of the soil (2000-75μ) contained about 80 percent of the phosphate that was applied as rock phosphate in this particle-size range.

Rothamsted Expt. Sta., Harpenden, Hertfordshire, England.

Van Diest, A. SOIL TEST CORRELATION STUDIES ON NEW JERSEY SOILS: I. COMPARISON OF SEVEN METHODS FOR MEASURING LABILE INORGANIC SOIL PHOSPHORUS. Soil Sci. 96: 261-266. 1963.

Seven laboratory methods for measuring labile inorganic soil P were examined on 10 soils from different land-type areas in New Jersey. Tomato was used as a test crop in the greenhouse. For a 3-month period preceding the growth of the test crop, groups of 3 pots of each soil were incubated with and without the addition of either limestone or superphosphate, or of both. The responses of the tomato plants and the various extraction methods to the P status of the soils resulting from the differential limestone and phosphate treatments were determined.

The coefficients of correlation between yield of P in tomato plants and labile P extracted by the extraction methods showed the water-extraction method used to be the most accurate one for predicting yield of P. The ammonium-lactate-acetic-acid method, which ranked second in accuracy of estimating yield of P, is, in contrast to the water-extraction method, potentially suitable for measuring estimates of labile P and estimates of exchangeable cations as well.

Responses of tomato plants to the limestone and superphosphate treatments varied widely among soils. The quantities of soil P extracted in the various laboratory tests were little affected by limestone applications.

Rutgers, the State U. N. J., New Brunswick, N. J.

Susuki, A., Lawton, K., and Doll, E. C. PHOSPHORUS UPTAKE AND SOIL TESTS AS RELATED TO FORMS OF PHOSPHORUS IN SOME MICHIGAN SOILS. Soil Sci. Soc. Amer. Proc. 27: 401-403. 1963.

Truog P, Bray P, Olsen P, resin P, and surface P were all determined on samples of 17 surface soils from Michigan (from 5 great soil groups), and each soil was cropped in the greenhouse with barley for 4 weeks to determine P uptake and A values. Ca-P, Al-P, Fe-P (by the Chang and Jackson procedure), and organic P were determined on 10 of these soils.

Correlation analyses indicated that short-term uptake of P by barley in the greenhouse was highly correlated with Truog P, while A values, which may be more indicative of seasonal availability, were most highly correlated with Olsen, resin, and Bray P. Organic P and Fe-P did not contribute to the P removed by any of the measurements. Truog P apparently removed portions of both the Ca-P and Al-P fractions, and P removed by cropping was also derived from these two fractions. All the other measurements were highly correlated with only Al-P.

Jr. Author, Mich. Agr. Expt. Sta., East Lansing, Mich.

MacKay, D. C., MacEachern, C. R., and Bishop, R. F. THE RELATION OF SOIL TEST VALUES TO FERTILIZER RESPONSE BY THE POTATO: II. NITRATE PRODUCTION AND NITROGENOUS FERTILIZER REQUIREMENTS. Canad. J. Soil Sci. 43: 242-249. 1963.

Bray's modified Mitscherlich equation was utilized to determine the relationship of potato yields (expressed as percentages of the maximum) to soil nitrate production and to rates of nitrogen fertilization at 18 locations in Canada over a 3-year period. A closer relationship was obtained using fresh soil samples than using those air-dried for 6 months.

The influence of various factors on absolute tuber yields (bushel/acre) was also assessed by analysis of variance. Highly significant effects were obtained for "rates of nitrogen" and for "soil test values" but not for the interaction of these two factors. The polynomial response curves derived from the analysis of variance showed that maximum yields were approached at a rate of 200 lbs./A. of applied N, whether soil nitrate production values were low, medium, or high. Tuber yields were also influenced by soil series and the amount of N fertilizer required for maximum yield was greater for some series than for others.

Expt. Farm, Res. Br., Canada Dept. Agr., Charlottetown, Prince Edward Island, Canada.

Robertson, W. K. INTER- AND INTRA-STOLON MOVEMENT OF FERTILIZER NUTRIENTS IN ST. AUGUSTINEGRASS AS AFFECTED BY MOISTURE STRESS. Soil Sci. Soc. Amer. Proc. 27: 385-388. 1963.

Single stolons from Floratine St. Augustinegrass plants were rooted in successive pots of Arredonda fs or Red Bay fsl resulting in a mother plant and several daughter plants in series. Movement of phosphorus and calcium in each stolon or series of plants was measured by placement of P-32 and Ca-45 in a pot near the middle of a series.

Phosphorus moved out from the treated pot in both directions but was greater in the direction of increased moisture stress in pots whether towards the growing tip or back towards the mother plant. The amount and distance of Ca movement was much less than that of P; however, moisture stress effects were similar. Calcium moved farther and in larger concentration when the soil was low in Ca than when it was high.

When two stolons were grown so that they had roots in one common pot, P-32 placed in the pot next to the common pot in one stolon moved to the second stolon and the movement was greater when the second stolon was under moisture stress. Similar studies with Ca-45 showed only very little transfer of activity from one stolon to the other regardless of the moisture condition. When water was withheld from a pot, the stolon continued to transfer water and nutrients to the growing top although there appeared to be no further root growth.

Fla. Agr. Expt. Sta., Gainesville, Fla.

Soil Biology

Cunningham, R. K. THE EFFECT OF CLEARING A TROPICAL FOREST SOIL. J. Soil Sci. 14: 334-345. 1963.

Organic matter in tropical soils under forest is delicately balanced, the continuous addition of fresh material being offset by decomposition. The forest was cleared from a soil in Ghana and three degrees of exposure were tested. Chemical and physical properties were measured from 1957 to 1960.

Much organic C, total N, and organic P was lost from the soil of fully exposed plots, because soil temperatures increased and fresh organic matter was no longer provided by the forest. Rate of decomposition lessened with time. Decomposition under shade, though still rapid, was significantly slower than in exposed soil. After 3 years, the exposured soil produced less mineral N and had smaller cation exchange capacity, exchangeable K, and lower pH than the shaded soil. Exposure also compacted the soil, impeded drainage through the 2-6 in. layer, and made the soil erode more easily.

Rothamsted Expt. Sta., Harpenden, Hertfordshire, England.

Miller, R. H., and Schmidt, E. L. MANOMETRIC STUDY OF NITROGEN UTILIZATION DURING EARLY STAGES OF CELLULOSE DECOMPOSITION IN SOILS. Soil Sci. Soc. Amer. Proc. 27: 374-377. 1963.

Cellulolytic activity in 50-g. samples of Nicollet sicl and Anoka lfs was followed continuously in a Warburg respirometer for periods of 240 to 331 hours. Experiments with varying rates and kinds of inorganic N treatments and with varying rates of cellulose substrate led to the determination of oxygen uptake curves, which were descriptive of the maximal rate of cellulose decomposition for each soil. Additions of 5 mg. of ammonium-N and 1.0 g. of cellulose gave maximal activity in the Nicollet, while an addition of 15 mg. of ammonium-N and 1.0 g. of cellulose was necessary to obtain similar activity in the Anoka. Treatment with P was found necessary for the Anoka but not for the Nicollet to achieve maximal cellulolytic activity.

The acceptability of humic acid to the cellulolytic microflora as a source of N was compared to that of inorganic N. Oxygen uptake curves reflected differences in the availability of humic acid N to the cellulose-decomposing microflora of the two soils, but availability was slight in either soil.

U. Minn., St. Paul, Minn.

Mack, A. R. BIOLOGICAL ACTIVITY AND MINERALIZATION OF NITROGEN IN THREE SOILS AS INDUCED BY FREEZING AND DRYING. Canad. J. Soil Sci. 43:316-324. 1963.

Rapid freezing and short-term drying effected marked changes in the biological activity of a Calcareous Black and a Brown Forest soil and only minor changes in a Solodized Solonetz soil which had a lower organic carbon and total nitrogen content. Freezing increased the initial rate of organic matter decomposition but further studies, with the Brown Forest soil only, showed that freezing did not affect the total amount decomposed over an extended incubation period; drying, however, increased the total amount decomposed throughout the incubation period. Freezing all soils decreased the number of viable fungi, whereas drying had no marked effect on the number of either fungi or bacteria. Freezing markedly increased the mineralization of nitrogen in the two higher organic matter soils whereas short-time drying did not. The influence of freezing on mineralization was reflected by a greater uptake of nitrogen by millet in one of the soils.

Canada Dept. Agr., Ottawa, Ontario, Canada

Schreven, D. A., Van THE EFFECT OF SOME ACTINOMYCETES ON THE GROWTH AND NITROGEN-FIXING POWER OF AZOTOBACTER CHROOCOCCUM. Plant and Soil 19: 1-18. 1963.

The antagonistic effect of 22 actinomycetes was tested by the agar streak method against a number of Azotobacter strains. In an agar medium containing 13 mg. nitrogen in the form of yeast extract, the antibacterial effect was generally far less marked than in a medium containing 13 mg. nitrogen in the form of peptone. Obviously peptone may exert a special influence on the production of antibiotics in a number of actinomycetes.

The sensitivity of different A. chroococcum strains towards the actinomycetes differed considerably.

When the procedure of re-isolation of Azotobacters from the inhibition zones and exposure of the re-isolated Azotobacters to the activity of the same actinomycetes were repeated several times, sometimes the resistance of the Azotobacter cells towards the actinomycetes increased to a greater or lesser extent. This was manifested either by a less clear inhibition zone, a shorter inhibition zone, or by the absence of an inhibition zone after 4 days.

The antibiotic effect of Streptomyces lavendulae, Str. griseus, and Str. griseolus was entirely prevented by the addition of 2 percent (w/v) alder bog peat with a moisture content of 60 percent. This could not be attributed to a decreased pH of the medium in the presence of the peat since an antibiotic effect was noted at the same pH in the absence of peat.

A strong suppression of the antibiotic activity was noted when 1 to 2 percent silt, clay, or norit were added to the medium. The clay particles consisted mainly of common (Fithian) illite (d = 10.8 Å).

In most cases, the nitrogen-fixing capacity of the Azotobacter strains were not changed by repeated exposure to actinomycetes with a strong antagonistic effect upon the bacteria. Only one strain increased significantly its nitrogen fixing power after being exposed 5 times to Str. lavendulae.

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The Netherlands

Smirnov, V. M., Grishkun, Y. V., and Usynina, V. A. ENZYMIC ACTIVITY AND INTENSITY OF SOIL RESPIRATION IN THE FOREST AND IN THE FIELD. Soviet Soil Sci. 1: 49-62. Jan. 1963.

The biological activities of soils in certain types of forests in the southern belt of the forest zone, and of a number of soils under various agricultural land uses, were objectively evaluated to assess their fertility. The authors concluded that:

1. Forest soils had a higher biological activity than field soils of the same group and texture. The only exception were field soils under perennial grasses.
2. Soils from cut-over forest areas now occupied by wiregrass and described as well-humified, sod-weakly podzolic clay loam soils on calcareous parent material, once occupied by coniferous-broadleaf plantations had the highest biological activity of all the forest soils. Sod-medium podzolic clay loam soils on non-calcareous parent material, once occupied by broadleaf and coniferous-broadleaf forests had a lesser biological activity. Sandy podzolic soils under pine forests, especially dry pine forests, had the least biological activity.
3. In forest soils, forest litter had the highest biological activity, while the humus horizon was considerably less active. The deeper horizons of podzolic soils had little biological activity.
4. The nitrogen nutrition in coniferous and coniferous-broadleaf plantations was achieved chiefly in the ammonium form.
5. Among the field soils studied, the most active biologically were humic-calcareous, dark-colored (sod-gley), weakly podzolic soils with a ground moisture regime, and clay loam ordinary chernozem. The least active were podzolic and sandy soils.

6. In contrast to forest soils, there was no sharp predominance of ammonium nitrogen over nitrate nitrogen in the field soils of the forest zone. At the same time there was no clear difference between the nitrification capacity of these soils.
7. Clay loam chernozem soils of the forest steppe had the most favorable biological properties. Humic-calcereous and dark-colored (sod-gley), weakly podzolic soils with a ground moisture regime come close to it in biological and enzymic activity. But chernozem excells them greatly by its high nitrifying capacity.

Scripta Technica Inc., 1000 Vermont Ave. N.W., Washington, D.C., 20005

Papadakis, J. PLANT POPULATION STRESS AND ANTIBIOTICS OF THE RHIZOSPHERE. Soil Sci. 96: 257-260. 1963.

It was shown experimentally that plant population may vary between wide limits without appreciable effects on crop yields. This fact shows that yield per plant is proportional to the space occupied. In the early days of agronomy this fact was attributed to plant competition for water and nutrients. Later, many researchers attempted to explain it as competition for light. But neither of these hypotheses has proved to be satisfactory. Population stress is more severe in fertile soils; and there is abundant evidence that 1500 to 2500 ft.-c. are sufficient for maximum photosynthesis.

An hypothesis advanced by Pickering, and confirmed experimentally by this writer, is that roots excrete substances that make the surrounding soil inadequate for growth. By watering wheat plants with a nutritive solution in which weed roots were growing, yields were reduced by 65 percent when the nutritive solution was strong, and by 58 percent when it was twice as dilute.

These experiments should be correlated with those of Norman, who has shown the existence of antibiotics in the rhizosphere that are injurious to root growth and nutrient absorption. It may be that Pickering's toxins are antibiotics produced by microorganisms living on root excretions.

Given that, according to Pickering, these substances are easily oxidized and absorbed. This hypothesis explains: why it is difficult to grow plants in solution, unless the solution is frequently changed and/or intensely aerated; why the addition of certain antibiotic-absorbing substances (resin, carbon, humus) permits better growth; why an increase in soil depth is so effective as an increase in area; and why, between certain limits, plant growth increases proportionately with soil colloids. This hypothesis also helps to explain why a luxuriant early growth is often injurious to yield, and to answer many other questions of crop husbandry and fertilization.

Instituto de Suelos y Agrotecnia, Buenos Aires.

Henderson, M. E. K., and Duff, R. B. THE RELEASE OF METALLIC AND SILICATE IONS FROM MINERALS, ROCKS, AND SOILS BY FUNGAL ACTIVITY. J. Soil Sci. 14: 236-246. 1963.

The decomposition of silicate minerals and related substances by fungi was investigated using two techniques: (1) The incorporation of the mineral material in agar medium, when its breakdown is indicated by the formation of clear zones round the fungal growth; and (2) the determination of the metal and silicate ions, derived from the insoluble materials and brought into solution as a result of fungal activity in liquid medium. Strains of fungi which produced citric and/or oxalic acid proved to be effective in decomposing certain natural silicates, while an oxalic acid-producing strain also released metallic ions and silica from rocks and soils. A possible role of fungi in biological weathering was discussed.

Macaulay Inst. Soil Res., Aberdeen, Scotland.

Martin, J. P., and Van Gundy, S. D. INFLUENCE OF SOIL PHOSPHORUS LEVEL ON THE GROWTH OF SWEET ORANGE SEEDLINGS AND THE ACTIVITY OF THE CITRUS NEMATODE (TYLENCHULUS SEMIPENETRANS). Soil Sci. 96: 128-135. 1963.

A study was made of the influence of the level of soluble soil-P on the establishment and detrimental activity of Tylenchulus semipenetrans in relation to growth of a first and second crop of sweet orange seedlings in Olivenhain sl, Merriam sl, Las Flores cl, and Tierra cl.

Relative growth of the first crop in each soil was dependent upon available soil-P level and the presence or absence of T. semipenetrans. This nematode reduced growth of the first crop 12 to 24 percent, and of the second crop, 17 to 28 percent. Plants in all soils responded to P fertilization. Applications greater than 360 lbs./A. tended to reduce growth, which was associated with low leaf-Cu (<3.5 p.p.m.) and high leaf- and root-P values. Soluble soil-P levels, which increased the root-P content above 0.3 percent, reduced numbers of T. semipenetrans. Their numbers increased more slowly in the clay loams than in the sandy loams, but after 15 months total numbers were highest in the alkaline Las Flores cl.

Relative growth of a second crop of seedlings was dependent upon soil-P level, the presence or absence of T. semipenetrans, and the establishment of other root parasites in the soil, including Thielaviopsis basicola. Total growth reduction of the second crop varied from 25 to 39 percent in the absence of these nematodes, and from 42 to 54 percent in their presence.

U. Calif. Citrus Res. Cent., Riverside, Calif.

Soil-Plant-Animal Relationships

Hamilton, J. W., and Beath, O. A. SELENIUM UPTAKE AND CONVERSION BY CERTAIN CROP PLANTS. Agron. J. 55: 528-531. 1963.

Barley, buckwheat, dent and flint corn, flax, ladino clover, millet, oats, rape, red clover, rye, safflower, sorgo, sudangrass, sugar beets, sunflower, and wheat plants were grown in the greenhouse on soils containing variable levels of selenium supplied as powdered seleniferous plants or as potassium selenate.

All the plants studied were capable of absorbing soil selenium whether it was applied in the organic or the chemical form. All portions of most plants contained both forms of selenium; however, there were exceptions. The grains of oats, rye, wheat, and safflower supplied organic selenium did not contain detectable amounts of selenate selenium. Sunflower plants absorbed relatively large amounts of selenium. Wheat was the most efficient selenium absorber among the cereal grains studied. The level of selenium present in corn and rape plants was much lower than results reported by other workers, and the reason or reasons were not apparent. The selenium contents of flax and safflower grains were low. Growing of these and other oil-producing plants upon soil containing available selenium was discussed.

This study emphasizes the potential danger that may result from consumption of plants grown on soils containing moderate levels of water soluble selenium. Most of the plant fractions grown and studied contained sufficient selenium to prove harmful to man or other animals eating these plants or plant products.

U. Wyo., Laramie, Wyo.

Hamilton, J. W., and Beath, O. A. UPTAKE OF AVAILABLE SELENIUM BY CERTAIN RANGE PLANTS. J. Range Mangt. 16: 261-265. 1963.

All plants studied, when grown on soils containing available selenium in the selenate, selenite, and organic form accumulated selenium in varying amounts in their tissues. Grasses varied widely in selenium-absorption efficiency. Indian ricegrass was the most efficient selenium-absorbing grass, western wheatgrass was somewhat less efficient. Common winter fat, broom snakeweed, kochia or burning bush, rabbitfoot grass, common dandelion, and yellow goatsbeard exhibited a somewhat lower selenium absorption efficiency. Alkali prince's plume contained a relatively high level of selenium which was present only in organic compounds. Tansy aster plants grown on soil containing inorganic selenium contained high levels of selenium.

In general, increasing the level of soil selenium resulted in increased selenium absorption by the plant. Selenate selenium was in most instances, absorbed most efficiently, selenite somewhat less efficiently, and organic applied selenium absorbed to a lesser extent. However, some plants readily absorbed comparatively large amounts of selenium from the soil when applied in the organic form. All plants changed inorganic selenium into the organic form. Plants grown on soils containing selenium in an available form should not be used for human consumption.

Livestock consuming plants containing appreciable quantities of selenium are capable of metabolizing the selenium, which is harmful to them. Milk, eggs, and meat obtained from selenium-fed animals will contain selenium.

Agr. Expt. Sta., U. Wyo., Laramie, Wyo.

Cannon, H. L. THE BIOGEOCHEMISTRY OF VANADIUM. Soil Sci. 96: 196-204. 1963.

Vanadium is known to occur in soils as vanadates of copper, zinc, lead, uranium, ferric iron, manganese, calcium, and potassium. Vanadium also replaces aluminum in clays and occurs in porphyrin complexes in bituminous sediments.

Small amounts of vanadium are stimulating to plants; large amounts are toxic. Ten to twenty p.p.m. vanadium in nutrient solution is commonly harmful to plants, but larger amounts can be tolerated by legumes, that use vanadium in the nitrogen-fixation process. Allium and some species of Astragalus, Castilleja, and Chrysothamnus are accumulators of vanadium.

The vanadium content of the above ground parts of plants rooted in highly calcic soils is very low, and that of plants rooted in seleniferous soils is high. The absorption and translocation of vanadium by several plant species was found to parallel that of selenium. Plant species that absorb large amounts of calcium are most tolerant of high-vanadium soils, as the vanadium is precipitated in the root.

Vanadium occurs in all animals and is accumulated in large amounts by ascidians and by holothuroidians. Vanadium is probably essential to vertebrates and has been shown to decrease dental caries in animals and children. Vanadium inhibits the biosynthesis of cholesterol in both animals and man. Seleniferous areas in the western conterminous United States commonly support vegetation that contains large amounts of vanadium. Many areas of this country, on the other hand, may be nutritionally deficient in vanadium.

U.S. Geol. Survey., Dept. Int., Denver, Colo.

Skogley, E. O., and McCants, C. B. AMMONIUM INFLUENCES ON RUBIDIUM ABSORPTION AND DISTRIBUTION BY TOBACCO SEEDLINGS. Soil Sci. Soc. Amer. Proc. 27: 549-552. 1963.

Mechanisms whereby NH_4 influenced the accumulation of cations in tobacco were investigated using short-term solution studies with Rb-86. Measurements on the influence of seedling size and absence of tops on the accumulation of Rb in roots indicated that the size of the plant was positively correlated with Rb accumulation only to the extent of 0.7. During a 6-hour period, roots had the major influence on Rb accumulation, the absence of tops made little or no difference. During this absorption period it was found that NH_4 had the same influence as K on the absorption of Rb, while after 24 to 48 hours NH_4, relative to K, had an additional depressive influence on Rb accumulation, especially in the tops of seedlings.

The possible involvement of NH_4 influences on transpiration rate and associated passive ion transport was investigated. No NH_4 influence on transpiration was found during periods extending to 70 hours. Salt treatments subsequent to Rb-86 treatments indicated that the distribution of Rb was dependent more on conditions during its absorption than on those imposed later. Results from these and other studies were used to develop a mechanism for Rb absorption and distribution by tobacco seedlings which accounted for the observed influences of NH_4 on Rb accumulation through an effect on absorption competition and metabolic ion transport.

Jr. Author, N.C. Agr. Expt. Sta., Raleigh, N.C.

Foy, C. D., and Brown, J. C. TOXIC FACTORS IN ACID SOILS: I. CHARACTERIZATION OF ALUMINUM TOXICITY IN COTTON. Soil Sci. Soc. Amer. Proc. 27: 403-407. 1963.

Aluminum toxicity is one of the limiting factors in acid soils. Increased yields of cotton and uptake of P were obtained by liming a Bladen cl soil. The same results were obtained in Al-containing nutrient solutions by increasing the pH of the solution or by adding increasing amounts of P. In each case, Al was precipitated and cotton absorbed more P, Ca, and K concomitant with increased yields. A P/Al ratio > 2 was required in solution before root branching and top growth of cotton occurred. Less added P was required for growth where Al was added at pH 5.0 than at pH 4.0.

The most characteristic symptom of Al toxicity in cotton was P deficiency. An accumulation of Al compounds in or on the root is believed to be detrimental to both chemical and physical absorption processes by the cotton plant.

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Sosulski, F. W., Paul, E. A., and Hutcheon, W. L. THE INFLUENCE OF SOIL MOISTURE, NITROGEN FERTILIZATION, AND TEMPERATURE ON QUALITY AND AMINO ACID COMPOSITION OF THATCHER WHEAT. Canad. J. Soil Sci. 43: 219-228. 1963.

The protein content of Thatcher wheat grown in the growth chamber was increased by reduced water supply, nitrogen fertilization, and higher air temperatures. Soil moisture conditions had a greater influence on protein content at higher temperatures, while the largest responses to nitrogen fertilization were obtained at the medium moisture level. Changes in sedimentation value and mixing time were associated with protein content except for plants grown at 62° F. Apparently the low temperature had an adverse effect on gluten quality.

The relative distribution of 9 amino acids was significantly correlated with changes in grain protein content. Only 6 amino acids gave similar high correlations with flour protein content and sedimentation value. These differences were explained on the basis of changes in the morphology of the wheat grain and the proportion of flour proteins.

U. Saskatchewan, Saskatoon, Saskatchewan, Canada

Skogley, E. O., and McCants, C. B. AMMONIUM AND CHLORIDE INFLUENCES ON GROWTH CHARACTERISTICS OF FLUE-CURED TOBACCO. Soil Sci. Soc. Amer. Proc. 27: 391-394. 1963.

Greenhouse studies indicated that NH_4 was a major causal factor in the development of leaf malformations similar to those of tobacco grown on fumigated soils and fertilized with NH_4-N. Chloride interacted with the form of N in its effect on leaf configuration, tending to increase the extent of abnormality when NH_4 was supplied but having little or no influence when NO_3 was supplied.

Utilizing a system in which NH_4, NO_3, and Cl were supplied from resins, NH_4, relative to NO_3, was found to decrease the percentage Ca, K, and Mg, and to increase the accumulation of NH_4 in the tissue. Chloride resulted in decreased NO_3, P, and S accumulation in the leaf and interfered with the incorporation of soluble N into insoluble N compounds.

Growth and accumulation of K, Ca, Mg, P, and N by plants supplied with NH_4 during a 21-day period was <30 percent of that of No_3-supplied plants. A study on the influence of NH_4 as the source of N relative to K deficiency indicated that less growth was obtained from a complete solution in which N was supplied as NH_4 than from one with K omitted but containing NO_3-N.

Jr. Author, N.C. Agr. Expt. Sta., Raleigh, N.C.

Cannell, G. H., Bingham, F. T., Lingle, J. C., and Garber, M. J. YIELD AND NUTRIENT COMPOSITION OF TOMATOES IN RELATION TO SOIL TEMPERATURE, MOISTURE, AND PHOSPHORUS LEVELS. Soil Sci. Soc. Amer. Proc. 27: 560-565. 1963.

Tomato plant growth was determined for 4 soil temperatures in combination with 2 soil moisture conditions and 3 phosphorus levels. There was a curvilinear relationship between yield and temperature. The highest yields were at 68°F., low soil suction, and high phosphorus. Yields increased with decreasing soil suction and with increasing phosphorus. Chemical leaf analysis, with exception of Mg, showed Ca, K, P, N, Cu, Fe, Mn, and Zn to vary significantly with temperature changes. Ca, Mg, K, N, Mn, and Zn were increased with decreasing soil moisture. Ca, Mg, K, Fe, and Zn tended to decrease with higher rates of phosphorus and P, N, Mn, Cu, and yield increased.

U. Calif., Riverside, Calif.

Kretschmer, A. E., Jr., and Hayslip, N. C. EVALUATION OF SEVERAL PASTURE GRASSES ON IMMOKALEE FINE SAND IN SOUTH FLORIDA. Fla. Agr. Expt. Sta. B. 658, 25 pp. 1963.

An experiment was conducted on a flatwoods soil (Immokalee fs) to compare certain growth habits, yields, and quality of various grasses.

Under a fertilization program of once-a-year application or fertilization after each cutting, pangolagrass and the bermudagrasses generally yield more dry matter than Argentine bahiagrass, Pensacola bahiagrasses, and carpetgrass. Most of the yield advantage came during the winter months, when the bahiagrasses and carpetgrass yields were greatly reduced.

Even under heavy fertilization, grass growth was greatly reduced after September or October and did not increase again until late spring.

Summer growth of all grasses except carpetgrass was good.

Protein contents generally were greatest for the bahiagrasses and carpetgrass and least for pangolagrass.

During the late spring and summer months, the protein content of pangolagrass dropped rapidly after reaching a maximum following fertilization. Under heavy fertilization and frequent cutting, however, levels remained consistently high. This tendency to "lose" protein rapidly was evident with the bermudagrasses, but less apparent with the bahiagrasses and carpetgrass.

Dry matter contents were highest for the bermudagrasses, followed by the bahiagrasses and then pangolagrass.

Deficiency of potassium generally resulted in: A reduction of grass growth; increased percentage protein contents; reduced total amount of protein contained in the tops; lower potassium contents; and increased weed populations.

Clipping frequently at a height of about 5 inches resulted in larger yields for all grasses than clipping at a 2½-inch cutting height during a high fertilization program.

The bahiagrasses and pangolagrass more effectively prevented grass and broadleaf weed encroachment, followed closely by carpetgrass and then by bermudagrasses.

U. Fla. Agr. Expt. Sta., Gainesville, Fla.

Washko, J. B. FERTILIZER EXPERIMENTS WITH SUMMER ANNUAL FORAGE CROPS. Pa. Agr. Expt. Sta. Prog. Rpt. 243, 4 pp. 1963.

Fertilizer investigations were conducted over the 3-year period, 1958-60, to determine the affects of applied nitrogen, phosphorus, and potassium on forage production and quality of four summer annuals: Hybrid corn; forage sorghum; sudangrass; and pearl millet. The first year, nitrogen, at 4 levels, 0, 50, 100 and 200 pounds per acre, was applied with 100 pounds each of phosphorus (P_2O_5) and potash (K_2O). The succeeding 2 years N, P_2O_5, and K_2O were applied in all combinations at 50, 100, and 200-pound rates. The results were:

1. Nitrogen produced the greatest yield responses.
2. Forage yields increased as nitrogen rates were increased from 50 to 200 pounds per acre unless rainfall was a limiting factor. The 100-pound rate appeared to be the most satisfactory from the standpoint of yield increase, TDN content of forage, and cost of nitrogen.
3. In the drought year of 1960, the 3 levels of applied nitrogen, 50, 100, and 200 pounds per acre, produced approximately the same amount of dry matter for all species.
4. Protein contents of the forages ranged from 7.7 percent at the 50-pound nitrogen rate to 11.4 percent at the 200-pound rate for all forages.
5. Crude fiber contents of the forages seemed to be influenced little by nitrogen applications.
6. P_2O_5 and K_2O application rates over the range of 50 to 200 pounds per acre in conjunction with the different N rates had little effect on either forage production or TDN contents.
7. Neither the 1-to-1 or 1-to-2 ratio at which the P_2O_5 and K_2O were applied with N had any appreciable effect on forage production or its TDN content.

8. Annual species used appeared to be of greater importance in determining dry matter production and TDN contents of the forages than fertilization practices.
9. During seasons of satisfactory rainfall, drilled hybrid corn produced the highest forage yields, sorghum was second highest, and sudangrass and pearl millet were of approximately equal value.
10. TDN contents of the forages were determined primarily by the species grown; corn was highest and pearl millet lowest. Over the 3-year period, TDN contents averaged: Pa 602 hybrid corn, 64.9 percent; forage sorghum (Black Amber and R. S. 301F), 61.1 percent; Piper sudangrass, 58.8 percent; and Gahi-1 pearl millet, 56.4 percent.

Pa. State U., Col. Agr., Agr. Expt. Sta., University Park, Pa.

Marten, G. C., Wedin, W. F., and Hueg, W. F., Jr. DENSITY OF ALFALFA PLANTS AS A CRITERION FOR ESTIMATING PRODUCTIVITY OF AN ALFALFA-BROMEGRASS MIXTURE ON FERTILE SOIL. Agron. J. 55: 343-344. 1963.

A newly established stand of alfalfa-brome was subjected to 2 variables: 7 levels of N from 0 to 120 pounds per acre, and 8 alfalfa plant densities from 0 to more than 12 plants per square foot.

In the first production year, stands containing alfalfa yielded significantly more than pure brome, but crude protein in these forages did not differ. No differences in yield occurred between mixed stands with alfalfa densities of from 2 to 12 plants per square foot, but stands with more than 12 plants per square foot outyielded those with 2 or 4 plants. Nitrogen levels did not significantly affect either yield or crude protein content of any alfalfa density treatment.

No dry matter yield differences appeared between treatments with varying alfalfa plant densities or N levels in the second production year. Crude protein increased in all forages with N application. Treatments containing alfalfa produced forage with more crude protein than the originally pure brome.

The failure of stands with differing alfalfa densities to yield differently appeared to be at least partially due to production of more tillers by alfalfa plants in the less-dense stands.

Alfalfa plant density was a poor criterion of yielding capacity of alfalfa-brome in this experiment.

CRD, ARS, USDA, U. Minn., St. Paul, Minn.

McLean, A., Nicholson, H. H., and Van Ryswyk, A. L. GROWTH, PRODUCTIVITY AND CHEMICAL COMPOSITION OF A SUB-ALPINE MEADOW IN INTERIOR BRITISH COLUMBIA. J. Range Mangt. 16: 235-240. 1963.

The grazing season on the sub-alpine meadow varied considerably depending on the weather. When the weather was wet and cool during the spring and early summer, the meadow remained flooded and growth was retarded. When the summer was warm and the fall mild, regrowth added to the yield and nutritive value of the meadow. In most years, however, early-fall frosts prevented further growth.

Frequent clipping throughout the season depressed forage yields. Rest near the end of the grazing season appeared to improve yields the following year.

Chemical analyses suggest that if growing animals were grazed only on this meadow their diets would be inadequate after about mid-August. In addition, the low phosphorus content may slow up animal growth as early as the end of July in some years. Normally, livestock grazing in this zone have access to both meadow and spruce-fir forest types. Although the carrying capacity of the adjacent forest range is generally low, the nutrient levels of forest forbs and shrubs are considerably higher than those indicated for the meadow. It would be important to arrange that the animals have access to sufficient forest forage to adequately supplement their diets.

The yield response to phosphate fertilizer was substantiated by the low phosphorus values of the forage. The good response to lime on this slightly acid peat soil was probably due to its neutralizing effect resulting in accelerated decomposition and subsequent release of nutrients. Calcium and sulfur did not appear to be deficient.

The animals lost weight during September 1958 but gained weight in September 1959. Chemical analysis of the forage indicated that the crude protein content was higher and crude fibre content was lower in September 1959 than in 1958.

The downward trend in average daily gain, total gain per acre, and TDN produced per acre over the last 3 years suggests that the pastures were either overstocked or that season-long grazing was reducing forage production.

Canada Dept. Agr., Res. Sta., Kamloops, British Columbia, Canada

Smith, D. H. EFFECT OF FUMIGANTS ON THE SOIL STATUS AND PLANT UPTAKE OF CERTAIN ELEMENTS. Soil Sci. Soc. Amer. Proc. 27: 538-541. 1963.

Fumigants commonly used or studied in relation to pineapple production in Hawaii are D-D, EBD, BBC (1,2-dibromo-3-chloropropane), and methyl bromide. These fumigants sometimes increase and sometimes decrease the quantity of iron that may be extracted from the soil. Use of D-D and methyl bromide appears to improve the utilization of iron within the plant but not the uptake of iron by the plant. Fumigants sometimes lower the oxidation-reduction potential in otherwise unamended soil. When combined with easily decomposable organic matter, they very markedly reduce this potential. The effect of fumigants in increasing availability of manganese in the soil and to the plant may be large, and may persist for many months. Fumigants frequently increase the phosphorus content of soil extracts, and D-D has increased the phosphorus "A value" in greenhouse tests, but use of D-D or methyl bromide in the field consistently resulted in reduced phosphorus uptake by the plant.

Pineapple Res. Inst. Hawaii, Honolulu, Hawaii

Burton, G. W., Jackson, J. E., and Hart, R. H. EFFECTS OF CUTTING FREQUENCY AND NITROGEN ON YIELD, IN VITRO DIGESTIBILITY, AND PROTEIN, FIBER, AND CAROTENE CONTENT OF COASTAL BERMUDAGRASS. Agron. J. 55: 500-502. 1963.

An old sod of Coastal Bermudagrass growing on a Tifton ls and fertilized annually with 600 pounds of N and 1,500 pounds of 0-10-20 per acre year was harvested with intervals between cuttings of 3, 4, 5, 6, 8, 12, and 24 weeks for 24-week periods in the summers of 1959-61. The authors concluded that:

1. Average annual dry-matter yields of 6.8, 7.2, 7.9, 8.9, 8.9, 9.0, and 6.5 tons per acre were obtained from plots cut every 3, 4, 5, 6, 8, 12, and 24 weeks, respectively.
2. The 3-year average dry-matter analyses of Coastal Bermudagrass cut at 3- to 24-week intervals ranged from 18.5 to 8.4 percent for crude protein, 27.0 to 33.9 percent for crude fiber, and 199,900 to 32,800 I.U. per pound of vitamin A equivalent.

3. Leaf percentages (dry basis) for grass cut at 3- to 24-week intervals ranged from 85.2 to 36.0 percent.
4. In vitro analyses of forage gave dry-matter "digestibility" values ranging from 65.2 to 43.2 percent for grass cut at 3- to 24-week intervals.
5. Forage harvested in the first 6-week period was 4 percent more "digestible" than that harvested during the next two 6-week periods.
6. Coastal Bermudagrass cut at 4-week intervals for 2 years and fertilized with 0, 100, 200, 300, 600, and 900 pounds of N per acre per year plus adequate P and K yielded 1.14 to 6.81 tons of dry matter (per acre) that contained 9.9 to 17.3 percent crude protein, and 103,200 to 170,400 I. U. per pound of vitamin A equivalent.

Ga. Coastal Plain Expt. Sta., Tifton, Ga.

Soil Classification

Harradine, F. MORPHOLOGY AND GENESIS OF NONCALCIC BROWN SOILS IN CALIFORNIA. Soil Sci. 96: 277. 1963.

In North America, noncalcic brown soils occur almost exclusively in the interior valleys and foothill regions of northern California and in the coastal plain and valleys of southern California, excluding the desert region. This great soil group comprises approximately 17 percent, or 4.5 million acres, of the 26 million acres of valley and foothill lands in the State which support intensive agricultural and range pasture programs.

These noncalcic brown soils have inherent characteristics that are both beneficial and troublesome to agricultural use. Many of them are uniquely and consistently associated with management problems involving surface soil crusting, slow water penetration, and compaction of subsoil horizons.

The nature and severity of these problems depends upon whether they have been induced temporarily by improper management practices or whether they are pedologic in origin and too far advanced to be economically amended. In most cases, management difficulties are less severe when the noncalcic brown soils have some brunizemic or reddish brown lateritic characteristics.

The distinguishing characteristics of noncalcic brown soils are:

1. Very weak surface soil structures when moist, or essentially massive and hard to very hard when dry.
2. Low organic carbon content with maximum values of 1.5 percent in surface horizons, decreasing rapidly to amounts less than 0.5 percent in subsoils.
3. The color of soils will vary in accordance with the mafic mineral content of their soil material. As a general range, surface soils (moist and dry) are between 7.5YR and 10YR in hue, 4 to 6 in value, and 3 to 6 in chroma, with little change in the subsoils of young soils. In older soils, the subsoils become browner, yellowish red, or redder with age.
4. At all stages of profile development, the proportion of clay relative to silt plus clay increases with depth, and the ratio becomes progressively wider the older the soils.
5. The pH values increase with profile depth. Surface soil reactions are near neutral to slightly acid. Deep subsoils, with some exceptions, are near neutral to slightly basic in reaction.
6. The percent of base saturation is consistently higher than 50 in surface horizons and it increases in subsoils to values that often are higher than 80 or 90.
7. Calcium and magnesium are by far the dominant exchange cations with the exchange-calcium content ranging from 2 me. per 100 g. or less in surface horizons to about

15 in lower subsoils. Ca/mg ratios are greater than one, but variable in surface horizons and narrow, or with magnesium in excess of calcium in the subsoils of older profiles.

8. All stages of profile development, including the maximum with an iron-silica cemented hardpan, are attained within the noncalcic brown group of soils in California.

U. Calif., Davis, Calif.

Hutcheson, T. B., Jr., and Haney, D. C. SOLUM-PARENT MATERIAL RELATIONSHIPS FOR THREE SOIL PROFILES DEVELOPED FROM SEDIMENTARY DEPOSITS OF ORDOVICIAN AGE. Soil Sci. Soc. Amer. Proc. 27: 441-445. 1963.

The chemical and mineralogical relationships between three closely associated parent materials and the solum overlying each of them were studied. Curdsville limestone, Fairmount limestone, and Garrard siltstone formations from Garrard County, Ky., were used. Profiles of Maury, Kenton, and Lowell soil series, locally associated with these formations, respectively, were sampled down to bedrock. The top 12 inches of bedrock was also sampled.

Petrographic study indicated weathering of glauconite in the sand and silt fractions as the solum surface was approached. Likewise, a 10Å. component of the clay fraction, presumably glauconitic, decreased in abundance in the more weathered upper solum while vermiculite and other 2:1 expansible layer silicates became more abundant. Kaolinite was more abundant in the upper solum.

U. Ky., Lexington, Ky.

Ugolini, F. C., and Tedrow, J. C. F. SOILS OF THE BROOKS RANGE, ALASKA: III. RENDZINA OF THE ARCTIC. Soil Sci. 96: 121-127. 1963.

Rendzina soils are present on the Lisburne Limestone, Brooks Range, Northern Alaska. This is an arctic tundra region underlain by permafrost. The soils occupy no more than 1 to 5 percent of the limestone areas; the remaining landscape consists of barren, rocky land--including bedrock. The soils are highly organic, usually alkaline, and have a maximum thickness of 1 to 2 feet. The effect of pH, Ca, climate, and the limestone composition itself, on soil development was discussed.

It is believed that the organic matter in the limestone residue plays a major role in soil development. The possibility of designating those rendzina soils formed from the organic residues in limestone as cryptolithochromic rendzina, with those having recent organic matter accumulations as normal rendzina was briefly discussed. Rendzina soils bear a close resemblance to those dark organic-colored soils formed on black shales in the Brooks Range sector.

Rutgers--The State U. N.J., New Brunswick, N.J.

Kunze, G. W., Oakes, H., and Bloodworth, M. E. GRUMUSOLS OF THE COAST PRAIRIE OF TEXAS. Soil Sci. Soc. Amer. Proc. 27: 412-421. 1963.

Morphological, chemical, mineralogical, and physical data were reported for 13 profiles of Grumusols, representing 3 soil series, all of which developed in the Beaumont clay geological formation. These are the dominant soils in a narrow 10 million-acre strip, some 40 miles wide, that extends 300 miles in a southwest direction from the Texas-Louisiana border on the east to about Kingsville. Rainfall varies from an average of about 52 inches in the extreme eastern end of the area to about 25 inches in the southwestern part. The profile of Beaumont c, the dominant soil in the most eastern humid part, is acid throughout. Lake Charles c, which is dominant in the central part, is acid in the upper part but calcareous in the lower horizons. In contrast, Victoria c, the principal soil of the southwestern or driest part, is calcareous throughout. All three of the clay soils are dominated by montmorillonite, which is reflected in the chemical and physical properties. With the exception of calcium carbonate and soluble salts, all properties investigated were unusually uniform throughout the profile.

Fractionation studies of the clay separate indicate a very high degree of sorting of the clay fraction throughout the range of all soils sampled. It was hypothesized that low energy aqueous forces affected a relatively equal distribution of the clay fraction over the entire area sampled. Following uplift and emergence of the Beaumont clay formation, the major differences noted in the present profiles can be related to the climatic factor of rainfall.

Tex. Agr. Expt. Sta., College Station, Tex.

Radeke, R. E., and Westin, F. C. GRAY WOODED SOILS OF THE BLACK HILLS OF SOUTH DAKOTA. Soil Sci. Soc. Amer. Proc. 27: 573-576. 1963.

The morphology, classification, and laboratory characteristics of the wooded soils of the Black Hills of South Dakota were reported. Field morphology studies tentatively established the classification of these soils in the Gray Wooded Soil Group. Paired profiles representing the central concept of the Gray Wooded group were sampled and laboratory characteristics determined. These soils resemble Gray Wooded soils reported for Canada, Montana, and the Northern Lake States. Additional paired profiles of giant or maximal Gray Wooded profiles and Gray Wooded intergrade profiles also were sampled and were characterized. A description of a pygmy or minimal Gray Wooded profile was described but was not sampled for analysis.

SCS, USDA, Hot Springs, S. Dak.

Gangmark, H. A., and Sanford, F. B. THEORY ON DEVELOPMENT OF MOUNDS NEAR RED BLUFF, CALIF. Fishery B. 63(1): 213-220. 1963.

Photographs taken on the flood plain of the Sacramento River near Red Bluff, Calif., were presented showing present-day development of mounds in all stages from incipient to mature. A theory was given summarizing the photographic observations.

The essential feature of the theory was that the mounds were formed immediately downstream from certain plants such as mountain monardella (Monardella adoratissima Benth) and brickellbush (Brickellia californica) during flood seasons, owing to the resistance offered by the plant to the flow of water and consequent slowing of the stream and deposition of suspended soil. The ellipsoidal shape of the mounds was explained as the product of two opposing tendencies: Deposition and erosion. The deposition was elongated downstream from the plant, whereas the erosion tended to shape the deposit into hemispherical form--that being the most stable to changing direction of flow.

The parallel orientation of the long axes of the mounds was explained by all of the mounds being formed by deposition from the same stream.

No address given.

Heinselman, M. L. FOREST SITES, BOG PROCESSES, AND PEATLAND TYPES IN THE GLACIAL LAKE AGASSIZ REGION, MINNESOTA. Ecol. Monog. 33: 327-374. 1963.

Two related ecological projects concerned with forest sites and bog processes on the Lake Agassiz peatlands of northern Minnesota were conducted between 1955-61.

Black spruce sites in the Lindford Peatland, located in Koochiching County were studied. Factors investigated included bog topography, groundwater levels, water movement, peat characteristics, peat depth, distance from margins, substrata, soil temperatures, and soil freezing. Site index was the dependent variable. The physiography, peat stratigraphy, and vegetation of the area were interpreted in terms of results. Major conclusions were:

1. Depth to groundwater was correlated with site index only during periods of low water.
2. There was significant correlation between sites and water table fluctuations when a full water year was considered.
3. Some good sites had stronger water movement than poor sites, but the correlation between water-table slopes and site index was nonsignificant.
4. Distance from margins was negatively correlated with site index.
5. Total peat depth had a low negative correlation with site index. Some excellent sites were nevertheless found on peats as deep as 11 ft.
6. Thickness of the upper horizon of raw Sphagnum was negatively correlated with site index. On good sites there was rapid transition to well-decomposed woody or mixed peats.
7. During summer, soil temperatures at 6 in. were highest on poor sites.
8. Soil frost was shallow and discontinuous; it thawed earlier on the poorest sites and was rare after June. Permafrost was not found.
9. Basal forest peats over much of the Lindford Peatland suggest bog expansion and site deterioration. A C-14 date of 4,360 yrs. for the deepest peats placed the start of this peatland near the end of the Thermal Maximum.
10. Circulation of bog waters seemed to be the master factor controlling forest sites, yet the hydrologic situation had itself been modified by peat accumulation.

A study of bog processes and peatland types within Lake Agassiz was conducted as a survey of peat stratigraphy, physiography, and vegetation in key areas with pronounced vegetation patterns. Widespread evidence of bog expansion, rising water tables, and site deterioration was found. Basal forest peats were found beneath the poorest muskegs up to 2 mi. from margins. Myrtle Lake, one of few bog lakes, seems to have risen some 14 ft. with peat accumulation.

The identity of the patterned bogs and fens of this region was established. Features that clearly mark the Lake Agassiz peatlands as members of this circumboreal group include string bogs (Strangmoor), topographically oriented forest islands, and fields of regularly spaced islands.

The decisive influence of water movement patterns on floristics and forest sites was underscored. The key seems to be the degree of isolation from mineral-influenced ground water. The course of such waters through bogs is often marked by water-track vegetation types. A tentative classification of peatland types was proposed.

Theoretical implications were discussed. Neither the processes of bog expansion nor the patterned bogs and fens of the Lake Agassiz region fit the classical picture of succession in the Lake States. Conclusions were that: (1) Few bogs in this region are the result of a single successional sequence. (2) The bog types cannot be regarded as stages in an orderly development toward mesophytism. (3) Raising of bog surfaces by peat accumulation does not necessarily mean progression toward mesophytism. Such rises often cause concurrent rises of the water table and promote site deterioration. And (4) the climax concept does not contribute to understanding bog history in this region.

Lake States Forest Expt. Sta. FS, USDA, St. Paul, Minn.

Kollmorgen, H. L. ISOPACHOUS MAP AND STUDY ON THICKNESS OF PEORIAN LOESS IN NEBRASKA. Soil Sci. Soc. Amer. Proc. 27: 445-448. 1963.

An isopachous map showing the thickness of Peorian loess in most of eastern and southern Nebraska was prepared from test-hole data secured in ground water investigations. The data from over 1,200 test holes were plotted and isopachous lines were imposed to show the relative thickness of the loess mantle.

The deepest loess plotted was from 80 to 90 feet thick near the Sandhills and it became progressively thinner to the south and east. Immediately south of the Platte River Valley, the loess ranged from 40 to 60 feet thick and became thinner to the south and east.

SCS, USDA, Lincoln, Nebr.

St. Arnaud, R. J., and Whiteside, E. P. PHYSICAL BREAKDOWN IN RELATION TO SOIL DEVELOPMENT. J. Soil Sci. 14: 267-281. 1963.

Mechanical analyses as well as quartz distribution data for four soils, ranging from chernozemic Black to podzolic Grey Wooded, indicated that a redistribution in particle size had occurred in the solum horizons relative to the parent materials. This was attributed to the physical breakdown, in large part the result of frost action, of the larger rock fragments and minerals. While mechanical disintegration was greatest in the surface horizons, it was least pronounced in the Orthic Black profile and reached a maximum in the A_e horizon of the Grey Wooded Soil. Periodic moisture saturation in layers underlain by slowly permeable textural B horizons was suggested as favoring breakdown by frost action. Implications of such breakdown relative to studies of soil genesis was discussed.

U. Saskatchewan, Saskatoon, Saskatchewan, Canada.

Sawyer, C. D., and Pawluk, S. CHARACTERISTICS OF ORGANIC MATTER IN DEGRADING CHERNOZEMIC SURFACE SOILS. Canad. J. Soil Sci. 43: 275-286. 1963.

Humic acids, polysaccharides, and polyuronides were extracted from samples representative of the organic and mineral A horizons of two Dark Grey Wooded soils. These organic fractions were characterized in order to determine the alterations, if any, which may be evident in some of the organic constituents present at varying depths in the organic and mineral A horizons as a result of progressive podzolic degradation.

Humic acid content in the organic fraction was found to decrease with depth in the mineral A horizon. Methoxyl content of the purified humic acids averaged 0.26 me./g. and decreased with depth while the total acidity (phenolic and carboxyl acidity) averaged 7.6 me./g. and increased with depth. Nitrogen content of the purified humic acids averaged 2.6 percent and was relatively constant throughout the organic and mineral A horizons. The humic acid content of the undecomposed and semi-decomposed organic debris was only slightly lower than that of the A_h horizon. This was probably at least partially due to hydrolyses of organic matter during the harsh extraction of humic acids with warm 1.0 N NaOH.

Total polysaccharide and polyuronide content of these soils decreased rapidly with depth; however, this decrease paralleled the decrease in total organic carbon content.

Dist. Supervisor, Public Lands, Peace River, Alberta, Canada.

Ballantyne, A. K., and Clayton, J. S. THE RELATIONSHIP OF WATER-SOLUBLE CATIONS TO FIELD SEPARATIONS OF CHERNOZEMIC AND SOLONETZIC SOILS. Canad. J. Soil Sci. 43: 359-369. 1963.

It was suggested that cations present in extracts of water-saturated soil samples can be used to complement and substantiate the field classification of soils into the Solonetzic and Chernozemic Orders by the Canadian system, and that an evaluation of these cations together with pH can be used as substantiating criteria at the sub-group level.

Two hundred and ninety-one profiles, sampled by the Saskatchewan Soil Survey during the 1959-61 seasons, were separated into high, medium, and low sodium profiles and correlated with the field classification. Most of the high sodium soils were in the Solonetzic Order, and the medium and low sodium in the Chernozemic Order.

The proposed laboratory criteria gave over 80 percent agreement with the field classification at the order level. This percentage was obtained from a range of 97 percent for the Orthic Chernozem to 63 percent for the Solonetz profile. The agreement at the lower level varied from 95 percent for the Rego Chernozem to 38 for the Solonetz.

Canada Dept. Agr., Saskatoon, Saskatchewan, Canada.

Fehrenbacher, J. B., Wilding, L. P., Odell, R. T., and Melsted, S. W. CHARACTERISTICS OF SOLONETZIC SOILS IN ILLINOIS. Soil Sci. Soc. Amer. Proc. 27: 421-431. 1963.

Solonetzic soils, commonly termed "slick-spots," occupy more than 381,000 acres on nearly level uplands in south-central Illinois and western Illinois. These loess-derived soils, high in exchangeable Na, occur as irregular-shaped areas varying in size from <1 to >100 acres. They are intimately associated with rather strongly developed planosolic soils. The climate of this area is humid with mean annual isohyets and isotherms ranging from 36 to 42 inches and 54° to 57° F., respectively.

Compared morphologically to associated Planosols, solonetzic soils have similar horizon sequences, but lighter colored surface horizons; thinner subsurface horizons; less well developed, columnar-prismatic B horizons; and contain carbonate concretions randomly distributed throughout their B horizons. The solonetzic soils have higher pH values and greater extractable (water-soluble plus exchangeable) Na regimes than associated soils.

In B horizons, solonetzic soils have pH values >7.5 and extractable Na contents of 4 to 6 me. per 100 g., whereas assciated soils usually have pH values <6.5 and extractable Na contents <1.0 me. per 100 g. Extractable Na content declines with depth below the B horizon in the solonetzic soils, and is relatively low in the underlying Illinoian till paleosol and Pennsylvanian bedrock, suggesting that these two underlying materials are not the source of Na in solonetzic soils of Illinois.

U. Ill., Urbana, Ill.

Wilding, L. P., Odell, R. T., Fehrenbacher, J. B., and Beavers, A. H. SOURCE AND DISTRIBUTION OF SODIUM IN SOLONETZIC SOILS IN ILLINOIS. Soil Sci. Soc. Amer. Proc. 27: 432-438. 1963.

Possible sources of extractable Na (water-soluble plus exchangeable) considered for Illinois solonetzic soils were: Pennsylvania bedrock; Illinoian till; Farmdale and Peorian loess; and ocean salts from rain. Extractable Na in Illinois solonetzic soils originated chiefly from the weathering in situ of Na-rich feldspars of the parent loess. Members of the albite series (namely, albite and oligoclase) and the Na-rich microcline, anorthoclase, aggregate 70 to 80 percent of the silt-sized Na- bearing minerals which comprise 75 to 90 percent of the total mineral Na in these soils. Sufficient Na has weathered from the 50 to 5μ silt fraction in solonetz soils to account for accumulations of extractable Na currently present in their B horizons. Little evidence of local variability in loess or differential weathering between solonetzic and associated soils suggests that differential redistribution of soluble products of weathering is responsible for extractable Na accumulations in Illinois solonetzic soils. It is believed that the local distribution of solonetzic soils is correlated with more permeable till zones of the highly impervious, underlying Illinoian till paleosol. Based on this assumption, a redistribution mechanism involving aqueous movement and differential segregation of soluble products of weathering was presented.

U. Ill., Urbana, Ill.

Hallsworth, E. G. AN EXAMINATION OF SOME FACTORS AFFECTING THE MOVEMENT OF CLAY IN AN ARTIFICIAL SOIL. J. Soil Sci. 14: 360-371. 1963.

A preliminary study was made of the extent to which clay can be moved by percolating solutions through various mixtures of sand and clay. The variations studied were: Quantity of clay present; type of clay mineral; size distribution of the mineral skeleton; pH of the leaching solution; and the nature of the cations present. The movement of the clay was restricted as the proportion present increased, and appeared to cease when the quantity exceed 40 percent for kaolinite clay or 20 percent for montmorillonite clay. At these levels, however, a significant migration was found to occur down the cracks which developed when the soil was dried out.

The movement of kaolinite increased continuously with increase in pH. The movement of montmorillonite increased to pH 10 or pH 11, and then rapidly diminished. The effects of the cations showed an interaction with the pH of the leaching solution.

U. Nottingham, Nottingham, England.

Whittig, L. D., and Janitzky, P. MECHANISMS OF FORMATION OF SODIUM CARBONATE IN SOILS: I. MANIFESTATIONS OF BIOLOGICAL CONVERSIONS. J. Soil Sci. 14: 322-333. 1963.

Mechanisms of formation and accumulation of $Na_2 CO_3$ were studied in a graded sequence of salt-affected soils of the Sacramento Valley, Calif. The soils are confined within a drainageway which is inundated during winter with flood waters containing relatively low concentrations of neutral sodium, calcium, and magnesium salts. Heavy inundations and high water tables within the basin led to microbiological reduction of sulfate and ferric iron. The resulting sulfide is held within the soil as FeS whereas the CO_2 released by biological oxidation of abundant organic matter forms bicarbonate. Lateral and upward migration of bicarbonate-charged water from the drainageway basin to soils nearer the basin rim results in yearly increases in concentration of soluble salts within these soils. $Ca(HCO_3)_2$ and $Mg(HCO_3)_2$ migrate from the zones of maximum CO_2 production and precipitate as carbonates. $NaHCO_3$ continues to move, along with the capillary water, and accumulates in the rim soils. As water evaporates or is used by growing plants, loss of CO_2 from the $NaHCO_3$ occurs, resulting in the formation of Na_2CO_3. The high Na_2CO_3 concentration at these rim positions has resulted in removal of divalent bases from the exchange complex, an equivalent increase in exchangeable sodium, and high pH.

U. Calif., Davis, Calif.

Soil Sci. 96(1): 1-74. 1963.

This special issue of Soil Science was devoted to the Soil Survey Classification System proposed by the Soil Survey Staff and called the 7th Approximation. The following articles were presented:

Kellogg, C. E. WHY A NEW SYSTEM OF CLASSIFICATION? SCS, USDA, Washington, D.C., 20250
Smith, G. D. OBJECTIVES AND BASIC ASSUMPTIONS OF THE NEW SOIL CLASSIFICATION SYSTEM. SCS, USDA, Washington, D.C., 20250
Cline, M. C. LOGIC OF THE NEW SYSTEM OF SOIL CLASSIFICATION. N.Y. State Col. Agr., Cornell U., Ithaca, N.Y.
Simonson, R. W. SOIL CORRELATION AND THE NEW CLASSIFICATION SYSTEM. SCS, USDA, Washington, D.C., 20250
Johnson, W. M. RELATION OF THE NEW COMPREHENSIVE SOIL CLASSIFICATION SYSTEM TO SOIL MAPPING. SCS. USDA, Berkeley 1, Calif.
Tavernier, R. THE 7TH APPROXIMATION: ITS APPLICATION IN WESTERN EUROPE. U. Ghent, Ghent, Belgium.
Stephens, C. G. THE 7TH APPROXIMATION: ITS APPLICATION IN AUSTRALIA. Commonwealth Sci. and Indus. Res. Organ., Adelaide, Australia.
Riecken, F. F. SOME ASPECTS OF SOIL CLASSIFICATION IN FARMING. Iowa State U., Ames, Iowa.
Orvedal, A. C. THE 7TH APPROXIMATION: ITS APPLICATION IN ENGINEERING. SCS, USDA, FCB, Hyattsville, Md., 20781
Retzer, J. L. SOIL FORMATION AND CLASSIFICATION OF FORESTED MOUNTAIN LANDS IN THE UNITED STATES. FS, USDA, Washington, D.C., 20250

Soil Conserv. 29(5): 99-120. Dec. 1963.

This special issue of Soil Conservation was devoted to the use of soil surveys in Rural-Urban fringe areas. The following articles were given:

Quay, J. LAKE COUNTY USES SOIL SURVEY IN PLANNING ITS URBAN AREAS. Lake Co. Reg. Plan. Com., Barrington, Ill.
Newbury, R. L., and Bender, W. H. ELA TOWNSHIP'S PLANNING INVOLVES 119 SOILS. SCS, USDA, Urbana, Ill.
Kellogg, C. E. SOIL SURVEYS HELP PEOPLE MAKE OF THEIR LAND WHAT THEY WISH. SCS, USDA, Washington, D.C., 20250
Anderson, R. C. GOLF COURSE--HOMESITE DEVELOPER REVAMPED PLAN TO FIT THE LAND. Long Grove Country Club Estates, Long Grove, Ill.

Morris, J. G. HEALTH OFFICIAL SAYS SOIL SURVEY "ONE OF THE MOST USEFUL TOOLS". Lake County Health Dept., Waukegan, Ill.

So, F. S. URBAN GROWTH SPURS PLANNERS TO LOOK FOR BASIC LAND FACES. Amer. Soc. Planning Off., Chicago, Ill.

Offerman, E. E. CONSERVATION DISTRICT PROGRAM SERVES RURAL AND URBAN PEOPLE. SCS, USDA, Lake Zurich, Ill.

Klingebiel, A. A. SOIL SURVEYS "MOVE TO TOWN". SCS, USDA, Washington, D.C., 20250

Beater, B. E. SOIL PROFILES FOR DISPLAY PURPOSES. J. Soil Sci. 14: 262-266. 1963.

A technique for the preparation and preservation of soil profiles was described. Constructional details of the metal frame, methods for procuring the monolith in the field, and the subsequent facing of it were presented. The preservation or hardening of the soil monolith in its frame with plasticized poly-vinly acetate emulsion, stabilized with poly-vinyl alcohol, was found to be extremely effective.

S. African Sugar Assoc. Expt. Sta., Mount Edgecombe, Natal., Union S. Africa.

EROSION CONTROL

Erosion Equation

Chepil, W. S., Siddoway, F. H., and Armbrust, D. V. CLIMATIC INDEX OF WIND EROSION CONDITIONS IN THE GREAT PLAINS. Soil Sci. Soc. Amer. Proc. 27: 449-452. 1963.

A climatic index based on effective precipitation and wind velocity for a 3-year period ending May 31 can be used to predict with considerable certainty the severity of wind erosion conditions during the succeeding calendar year. On the basis of predicted severity of wind erosion conditions, farmers can be advised whether or not they should use special methods to control impending wind erosion.

Jr. Author, SWCRD, ARS, USDA, Manhattan, Kans., 66504

Olson, T. C., and Wischmeier, W. H. SOIL-ERODIBILITY EVALUATIONS FOR SOILS ON THE RUNOFF AND EROSION STATIONS. Soil Sci. Soc. Amer. Proc. 27: 590-592. 1963.

The universal soil-loss estimating equation introduced by Wischmeier is:

$$A = RKLSCP$$

where A is estimated soil loss, R is the rainfall-erosion index, K is the soil-erodibility factor, and L, S, C, P are factors for length and percent slope, cover, and mechanical conservation practices, respectively.

The soil-erodibility factor (K) is defined as the average soil loss per unit of the erosion index (R) from continuous fallow on a plot 72.6 feet long on a 9 percent slope. The value of this factor was approximated for 20 soil types represented on the U.S. Department of Agriculture runoff and erosion research stations located in the eastern half of the United States.

The estimated values were computed from the plot data, using these plots whose conditions most closely approximated base conditions of cover and geometry. Observed soil losses from cropped plots were adjusted to fallow conditions by use of previously published numerical values of C and P.

The resulting table of K values provides a list of benchmark values for estimating the erodibility of other soils.

SWCRD, ARS, USDA, Brookings, S. Dak., 57007

Wind and Water Erosion

Shrader, W. D., Johnson, H. P., and Timmons, J. F. APPLYING EROSION CONTROL PRINCIPLES. J. Soil and Water Conserv. 18: 195-199. 1963.

Though man has learned a great deal about erosion control and great progress has been made in applying erosion control practices on the land, soil erosion continues at an excessive rate in many areas. Failure to give adequate consideration to the problems associated with soil differences and lack of appreciation of the importance of economic factors in erosion control planning are important reasons why conservation practices are not being more intensively and extensively applied.

Erosion control must be achieved within the framework of agronomic and engineering technology, with concommitant consideration of the economic consequences of alternative procedures on a particular soil. Ways agronomists, engineers, and economists can and must work together in guiding the application of erosion control practices on the land were shown.

Iowa Agr. and Home Econ. Expt. Sta., Ames, Iowa.

Bourget, S. J., and MacLean, A. J. THE EFFECT OF WATER EROSION ON PHYSICAL AND CHEMICAL PROPERTIES OF RIDEAU CLAY. Canad. J. Soil Sci. 43: 370-376. 1963.

Loss of topsoil was appreciable where corn was grown up and down the slope regardless of manuring, but control of erosion was excellent where a rotation was followed that included a soil improving crop such as alfalfa. Cropping practices influenced the physical characteristics of the soil, in particular the quantity of water stable aggregates. Stable aggregates greater than 0.5 millimeter were highest in the alfalfa and lowest in the corn plots.

The organic matter and nitrogen contents of continuous corn plots decreased with time. These constituents were at least maintained where a rotation was followed and were increased in a continuous alfalfa plot. Sodium bicarbonate soluble phosphorus decreased during the experimental period regardless of management. However, erosion had no marked effect on the exchange properties of the soil.

Canada Dept. Agr., Ottawa, Ontario, Canada.

SOIL MANAGEMENT

Cropping Practices

Soil Conserv. 27(12): 267-287. July 1963.

This special issue of Soil Conservation was devoted to the results of soil conservation practices. The following articles were given:

Hedrick, C. CONSERVATION PROGRAM MAKES IDAHO RANCH PAY. SCS, USDA, Twin Falls, Idaho.
Chapman, C. W. WATERSHED DAMS PROVIDE BETTER COUNTY ROADWAYS. SCS, USDA, Athens, Ga.
Parmeter, W. N. GREAT PLAINS PROGRAM DROUGHT-PROOFS RANCH. SCS, USDA, Huron, S. Dak.
Wilkin, E. P. CONSERVATION ON DEFENSE LANDS. SCS, USDA, Washington, D.C., 20250.
Sisk, L. J. CONSERVATION SAFEGUARDS HISTORIC PEPPER FIELDS. SCS, USDA, Spartanburg, S.C.
Wilson, J. G. IOWA COUNTY PUSHES ROADSIDE EROSION CONTROL. SCS, USDA, Newton, Iowa.
McDowell, J. DUGOUTS SAVE WATER FOR NEBRASKA FARMS. SCS, USDA, Geneva, Nebr.
Anker, L. A. SOIL SURVEYS BASIS FOR LAND ASSESSMENTS. SCS, USDA, Gardnerville, Nev.
Slaton, C. CONSERVATION LAND PATTERNS DRAW WATERFOWL. SCS, USDA, Harrisburg, Pa.
Thomas, C. H., and Cross, J. FISHING PROFITS FROM ONCE USELESS LAND. SCS, USDA, Crowley, La.
Hortin, J. K. WATER ON WHEELS. SCS, USDA, Ogden, Utah.
Moustakis, C. G. CONSERVATION CONTRACTOR CONVERTS IDLE LAND TO RECREATION CENTER. SCS, USDA, Amherst, Mass.
Jones, H. I. CONSERVATION NATURE CENTERS--LABORATORIES FOR LAND LEARNING. SCS, USDA, Denver, Colo.
Hall, R. L. BORROW PIT MAKES GOOD ARCHERY RANGE. SCS, USDA, Snow Hill, Md.
Ross, W. CONSERVATION--A PROFITABLE WAY OF LIFE. SCS, USDA, Aberdeen, Idaho.
Preston, J. E. IRRIGATION IMPROVEMENT ASSURES GOOD HAY YIELDS. SCS, USDA, Walden, Colo.
Jaedicke, C. D. FROM BOXING TO RANCHING--A PROFILE. No address given.

Mazurak, A. P., and Ramig, R. E. RESIDUAL EFFECTS OF PERENNIAL GRASS SOD ON THE PHYSICAL PROPERTIES OF A CHERNOZEM SOIL. Soil Sci. Soc. Amer. Proc. 27: 592-595. 1963.

Residual effects of perennial grass sod on a Chernozem soil were studied in two experiments. In the first experiment, two cool-season grasses were in sod for 2, 4, 6, and 8 years in the second 10-year cycle of a 20-year study. Sod was plowed and then cropped to a fallow-wheat sequence for 4 years. In the second experiment, seven cool-season and four warm-season grasses were in sod for 7 years. Sod was plowed and then cropped to a fallow-wheat sequence for 6 years. In both experiments the plots were split or paired and one-half of each plot or one of each pair of plots received nitrogen fertilizer.

In the first experiment, the residual effects of grasses on the rates of water entry into soil and on the water stability of aggregates were evident 4 years after plowing sod. The degree of residual effect increased as the years in sod prior to plowing increased. Residual effect of grasses augmented the yields of wheat. In the second experiment, favorable effects of cool- and warm-season grasses were noted on the rate of water entry into soil.

Nebr. Agr. Expt. Sta., Lincoln, Nebr.

Kilcher, M. R., and Anderson, L. H. WHEAT YIELDS AND SOIL AGGREGATION AFTER PERENNIAL GRASSES IN A SEMI-ARID ENVIRONMENT. Canad. J. Plant Sci. 43: 289-294. 1963.

Spring wheat grown the year following breaking of stands of crested wheatgrass (Agropyron cristatum L.) or bromegrass (Bromus inermis Leyss) in a semiarid region of the Canadian prairies yielded 17 percent less than wheat grown on summerfallow in a 2-year wheat-summerfallow rotation. After three successive cycles of the 2-year wheat-summerfallow rotation on the sod breaking, the wheat yields were about equal to those obtained from the check plots. The grasses did not improve soil aggregation any faster than that which occurred in the wheat-fallow regime under an adopted strip cropping management.

Expt. Farms, Canada Dept. Agr., Swift Current, Saskatchewan, Canada.

Brawand, H., and Laws, W. D. SOIL MOISTURE CONSERVATION AND UTILIZATION IN FARMING SYSTEMS FOR THE BLACKLANDS. Hoblitzelle Agr. Lab., Tex. Agr. Found. B. 16, 37 pp. 1963.

The conservation of soil moisture by means of farming systems for 1956-60 were reported. Moisture data for cotton from three farming systems, sorghum from three farming systems, and farming systems including corn, hay, and wheat were presented. The yields were compared to the available water in the top 25 inches of soil as well as to the total water used for the growing season.

The farming systems had a significant effect on the available water reserve of the cotton. The average moisture reserve for the unfertilized, continuous cotton was 1.18 inches, which was significantly lower than the reserves of 1.53 and 1.46 inches for fertilized cotton in rotation.

The yields of the fertilized cotton in rotation were significantly higher than the yields of the unfertilized continuous cotton. The 5-year averages were 769 and 754 pounds of seed cotton for the fertilized rotations compared with 520 for the continuous cotton.

It took 7,491 pounds of water to produce 1 pound of seed cotton in the unfertilized continuous system, whereas 6,503 and 5,897 pounds sufficed for fertilized cotton in rotation.

The low yielding system produced 32 pounds of seed cotton per acre-inch of water used, and the better systems yielded 44 and 45 pounds.

The regression equation relating seed cotton yields to July moisture reserve indicates that a seed cotton yield response of 135 pounds per acre-inch change in soil moisture could be expected with the low producing system. Comparable yield increments were 277 and 264 pounds for the fertilized rotation systems.

For 1956-60, the available water reserve averaged 2.34, 2.18, and 2.16 inches in plots of three sorghum systems.

The unfertilized continuous sorghum produced 1,970 pounds of grain per acre, while the fertilized rotation system produced 3,161 pounds of grain per acre. The unfertilized sorghum in rotation produced 2,561 pounds of grain. Aboveground dry matter production of 5,301, 6,639, and 7,998 pounds per acre was estimated for the three systems.

Grain yield and available moisture in the soil were shown to be well correlated. Evaluation for March indicated yield responses of 605, 885, and 686 pounds of grain per acre-inch of variation in water supply, for the three cropping systems. The comparable regression coefficients in April showed 508, 769, and 631 pounds of grain per inch of change in water supply.

Corn grown in a 4-year rotation with each crop fertilized every year compared very favorably with sorghum grown in a 3-year rotation with fertilizer applied 1 year out of 3. However, the corn did not compare favorably with sorghum grown in a 4-year rotation with every crop fertilized. This sorghum produced 22.6 percent more total salable crop, and 66 percent more total dry matter. It also produced 30 percent more salable crop per acre-inch of water utilized. The water use per unit of salable crop by the corn was 58 percent more than that used by the fertilized sorghum in rotation and water use per unit of aboveground dry matter was 104 percent higher for the corn than for the sorghum.

The sod crop was included in the original experiment because of the success of grassland farming in other regions. The hay yields were low and production per acre-inch of water was only 128 pounds of hay as compared with 70 pounds of grain per acre-inch of water used by wheat. The difference in the value of the two crops was in favor of wheat over sod in the rotation.

Hoblizelle Agr. Lab., Tex. Res. Found., Renner, Tex.

Derscheid, L. A., Wallace, W. H., and Wrage, L. J. CROPPING, CULTIVATION, AND HERBICIDES TO ELIMINATE RUSSIAN KNAPWEED AND PREVENT REINFESTATION. Weeds. 11: 237-242. 1963.

Stands of Russian knapweed (Centaurea repens L.) were reduced over 80 percent by several combinations of crops, cultivation, and herbicides. Two of the best crop rotations in a 4-year trial were: (1) A short season of intensive cultivation and a mid-August seeding of bromegrass that was sprayed with 1 lb./A. of 2,4-D during June and 1 or 1 1/2 lb./A. during August of the second and third years; and (2) bromegrass seeded with an oat companion crop sprayed with 1/3 lb./A. of 2,4-D ester the first year and annual applications of 2,4-D in June and mid-August during the second and third years.

The best use of non-selective herbicides in two 2-year trials was spring application of 4 lb./A. of 2,3,6-TBA or 6 lb./A. of PBA plowing 10 days later, and a corn crop sprayed with 1/3 lb./A. of 2,4-D ester followed by a spring-seeded oat crop sprayed with 1/3 lb./A. of 2,4-D ester and postharvest application of 4 to 6 lb./A. of 2,3,6-TBA and 6 to 8 lb./A. of PBA, and plowing 10 days later. Reinfestation from established plants was not prevented, but annual application of 2,4-D prevented reinfestation from seedlings.

S. Dak. Agr. Expt. Sta., Brookings, S. Dak.

Dowler, C. C., Sand, P. F., and Robinson, E. L. THE EFFECT OF SOIL TYPE ON PREPLANTING SOIL-INCORPORATED HERBICIDES FOR WITCHWEED CONTROL. Weeds 11: 276-279. 1963.

Preplanting, soil-incorporated treatments of fenac at 1, 2, 4, and 8 lb./A., 2,3,6-TBA at 8, 12, and 16 lb./A., and 2,4-D at 12 lb./A. when applied in 1960 to six soil types infested with witchweed (Striga asiatica (L.) Kuntze) resulted in some control of witchweed as measured by visual observations and corn yield. Two or three additional postemergence applications of 2,4-D at 1 lb./A. were required to prevent witchweed seed production for the growing season. Witchweed parasitism on corn was greatly reduced by a preplanting treatment of fenac at 2 lb./A. plus 2,4-D as a postemergence treatment.

All rates of 2,3,6-TBA and fenac at 8 lb./A. caused moderate to severe corn injury with the most severe injury occurring on soils with a relatively high clay content in the subsoil. Soil residual studies and field observations indicated fenac and 2,3,6-TBA were sometimes present in Coastal Plain soils for more than 18 months.

PPCD, ARS, USDA, Whiteville, N.C.

McWhorter, C. G. EFFECTS OF SURFACTANTS ON THE HERBICIDAL ACTIVITY OF FOLIAR SPRAYS OF DIURON. Weeds 11: 265-269. 1963.

Inclusion of any one of several ethoxylated nonionic surfactants in aqueous spray mixtures of diuron greatly increased its toxicity to crabgrass (Digitaria sanguinalis L.). Phytotoxicity of sprays made up from commercially formulated diuron was greater than when technical diuron was used. The toxicity of diuron was also increased by the addition of any of several low-molecular-weight alcohols to the spray mixture.

The turbidity of diuron suspensions was greatly decreased by addition of any of several nonionic, anionic, or cationic surfactants which contained a fatty acid or fatty acid derivative as the hydrophobic portion of the molecule. Phytotoxicity of diuron applied with ethoxylated nonylphenol surfactants was associated with ethylene oxide (hydrophil) content. Surfactants containing nonylphenol, alkylthiol, or tridecylphenol as hydrophobes appeared essentially equal in their abilities to increase diuron toxicity, but dodecylphenol surfactants were slightly less effective.

CRD, ARS, USDA, Stoneville, Miss.

Hauser, E. W. RESPONSE OF PURPLE NUTSEDGE TO AMITROLE, 2,4-D, and EPTC. Weeds 11: 251-252. 1963.

The response of purple nutsedge (Cyperus rotundus L.) clones grown from single tubers to amitrole, 2,4-D, and EPTC and the response of established nutsedge to amitrole was studied under field conditions of the Georgia Piedmont Plateau. Clones were essentially eradicated by two applications of amitrole initiated up to 4 weeks after shoot emergence and by EPTC incorporated at 1 or 2 weeks after emergence. Excellent control resulted from 9 applications of 2,4-D initiated 1 or 2 weeks after shoot emergence. Timely applications of amitrole to an established stand controlled but did not eradicate nutsedge.

Coastal Plains Expt. Sta. CRD, ARS, USDA, Tifton, Ga.

Williams, M. C., and Cronin, E. H. EFFECT OF SILVEX AND 2,4,5-T ON ALKALOID CONTENT OF TALL LARKSPUR. Weeds 11: 317-319. 1963.

Amine salts of silvex and 2,4,5-T were applied to tall larkspur, (Delphinium barbeyi Huth,) at 2, 4, and 8 lb./A. on three dates. Leaf and stem samples collected 1, 2, and 3 weeks after treatment yielded significantly higher concentrations of alkaloids than did controls. Leaves and stems from plants treated with silvex contained more alkaloids than did those treated with 2, 4,5-T. Alkaloid concentration in the leaves varied directly with the rate of herbicide following the first treatment in mid-July, but this relation was not apparent in samples obtained from the third treatment in August.

CRD, ARS, USDA, Logan, Utah.

Carder, A. C. MONURON FOR ERADICATION OF QUACKGRASS. Weeds 11: 308-310. 1963.

In tests conducted from 1951 to 1961 in the Peace River section of Alberta, monuron was applied to vigorous quackgrass (Agropyron repens (L.) Beauv.) sods on different soils. These tests showed that: (1) Tillage either before or after application of monuron strongly reduced its effect; (2) when used without tillage it did not matter whether monuron was applied in the early summer or early autumn, but when used with tillage it was best applied in the early summer; (3) monuron 40 lb./A. applied without tillage eradicated quackgrass under all conditions except when it was established in an unusually deep and loamy soil; (4) killing quackgrass by monuron usually took 2 years; and (5) lethal rates of monuron prevented quackgrass re-establishment for from 1 to 7 years and satisfactory growth of cereal crops for 10 years or more.

Res. Off., Expt. Farm. Beaverlodge, Alberta, Canada.

Crop Residue Management

Fletcher, R. A., and Renney, A. J. A GROWTH INHIBITOR FOUND IN CENTAUREA SPP. Canad. J. Plant Sci. 43: 475-481. 1963.

The growth of tomato and barley plants was inhibited in soils naturally infested with knapweed or in soils artificially infested with powdered knapweed residues. The leaves contained a higher proportion of the toxic material than other plant parts, and the leaves of Centaurea repens L. were more inhibitory than those of Centaurea diffusa Lam. and Centaurea maculosa Lam. Chromatographic techniques were developed to isolate an inhibitor common to the three species, which was soluble in both water and ether, and inhibitory to the seedling development of barley and lettuce. The material was relatively more inhibitive to root development than to the top growth of the species tested. Chromogenic sprays and ultraviolet absorption spectra indicated that the inhibitor was an indole derivative. The presence of a plant growth inhibitor in these Centaureas may partially explain their rapid establishment in almost pure stands.

Dept. Plant Sci., U. British Columbia, Vancouver, British Columbia, Canada.

McAlister, J. T. MULCH TILLAGE IN THE SOUTHEAST: PLANTING AND CULTIVATING IN CROP RESIDUE. U.S. Dept. Agr., L. 512, 8 pp. 1962.

An illustrated guide on mulch tillage in the Southeast was given.

SCS, USDA, Inform. Div., Washington, D.C., 20250

Tillage

Lyles, L., Heilman, M. D., and Thomas, J. R. SOIL-MIXING CHARACTERISTICS OF THREE DEEP-TILLAGE PLOWS. J. Soil and Water Conserv. 18: 150-152. 1963.

The soil-mixing characteristics of three large plows, two disk type and one moldboard, were evaluated. Although there were no marked differences in soil-mixing characteristics among the plows, with all the plows there was considerable mixing of the plow layer. The two disk plows placed more of the top 0-to-4-inch depth increment in the bottom of the furrow slice than did the moldboard plow. However, measurements of total displacement of the 0-to-8-inch soil layer into the 8-to-16-inch layer indicated that there were no essential differences among the three plows studied.

The data suggest that deep plowing of "cut" areas prior to land leveling may prevent or alleviate the serious fertility problem associated with subsoil exposure.

SWCRD, ARS, USDA, Manhattan, Kans., 66504

Hamilton, H. A., and Lessard, J. R. CROP RESPONSE TO LIME AND FERTILIZER SUPERIMPOSED ON DIFFERENT TILLAGE TREATMENTS FOR A VIRGIN GREY WOODED SOIL. Canad. J. Soil Sci. 43: 298-308. 1963.

A virgin Grey Wooded soil was subjected to different tillage treatments receiving various rates of nitrogen, phosphorus, and lime. In a 5-year rotation of oats followed by 4 years of hay, oat forage yields with 24-inch plowing appeared to be less than those obtained with shallower tillage treatments, but the subsequent first- and second-year hay yields were substantially higher. Nitrogen and phosphorus significantly increased oat forage yields irrespective of tillage treatment. Increases in first-year hay yields due to residual phosphorus were highly significant with 12-inch and 24-inch plowing. Second-year hay yields were significantly increased by residual phosphorus on all tillage treatments with increases being in the order 12-inch plowing and disking greater than 6-inch and 24-inch plowing. Irrespective of tillage treatment, lowest hay yields were obtained in the first year of harvest. Despite the greater saturation of the sub-surface soil with bases, lime significantly increased hay yields on plots plowed to 24 inches. Whereas the legume component of the hay mixture was initially high on plots plowed to 24 inches, in the succeeding years the percentage decreased considerably. On the other hand, legume percentage, which was initially low, increased for plots that were disked or plowed to 6 inches. Plowing to a depth of 12 inches appeared to be the most satisfactory procedure in maintaining the best hay yields with a high percentage of legumes.

Canada Dept. Agr., Kapuskasing, Ontario, Canada.

Fertility Requirements for Conservation Farming

Armson, K. A. THE EFFECTS OF LEVELS AND TIMES OF FERTILIZER APPLICATION ON THE GROWTH OF WHITE SPRUCE SEEDLINGS. Soil Sci. Soc. Amer. Proc. 27: 596-597. 1963.

Four levels of nitrogen and phosphorus were added in combination on three different time schedules to white spruce seedlings during their second growing season. The three time schedules were: (1) "Periodic," in which fertilizer was applied in five dressings from

May to September; (2) "Normal," in which fertilizer was applied in May, June, and July; and (3) "Summer and Fall," in which fertilizer was applied in May, June, and September.

Seeding dry weight increased with increasing level of fertilizer application, but was not significantly affected by time of application. Seedling height showed a general increase with increase in amount of fertilizer. Shoot/root ratios increased with increasing level of fertilizer; however, by using a "Periodic" time schedule the increase was minimized. Nitrogen concentrations and contents in the foliage increased with increase in fertilizer level and "Periodic" and "Summer and Fall" applications resulted in larger concentrations than did those under the "Normal" time schedule. Foliage concentrations of phosphorus were not affected by any of the treatment.

U. Toronto, Toronto, Ontario, Canada.

Eck, H. V., Tucker, B. B., and Schlehuber, A. M. INFLUENCE OF FERTILIZER TREATMENTS ON YIELD, GRAIN PROTEIN, AND HEADING DATES OF FIVE WHEAT VARIETIES. Agron. J. 55: 556-558. 1963.

Five varieties of hard red winter wheat, Triticum aestivum L., were grown under 7 different fertilizer treatments for 8 years. Data on grain yield, grain protein, and heading date were collected for 7 years. Yield to P was obtained in 5 of 7 seasons, whereas yield response to N was obtained in only 3 of the 7 seasons. P fertilizer hastened maturity; N fertilizer delayed maturity. N fertilizer increased grain protein, whereas P fertilizer decreased grain protein.

The five varieties produced significantly different yields. The order of yield from high to low was Concho, Triumph, Ponca, Comanche, and Pawnee. Though there were significant differences in grain protein content, the spread among varieties was only 1 percent. Average heading date for Triumph was 8 days earlier than for the other varieties.

The single significant variety X fertilizer interaction obtained in this study, that in grain yield, resulted from a disproportionate yield increase from P fertilizer in one variety in one of seven seasons. The varietal yields tended to rank about the same over the various fertility treatments. The results indicate that if moderate fertility levels are maintained in variety trials and recommended varieties are used in fertility trials, single fertility levels are adequate for variety trials and single varieties are adequate for fertility trials.

SWCRD, ARS, USDA, Bushland, Tex., 79012

Dow, A. I., and Kunkel, R. FERTILIZER TESTS WITH POTATOES. Wash. State U. Ext. Serv. C. 335, 8 pp. 1963.

Fertilizer trials with potatoes were conducted in 1960 and 1962 in the Columbia Basin. In 1960, there were two trials involving rates of nitrogen, phosphorus, and potassium. The one trial in 1962 involved the time of applying fertilizer as well as the rate of application. From the results of the three trials the following statements were made:

1. All trials showed a strong yield response to nitrogen.
2. In the 1960 trials, where the soil test was "low" or "very low" in phosphorus and potassium, there was a distinct yield response to those two elements. In the 1962 trial, where the soil test was "high" in phosphorus and potassium, there was no response.
3. Both yield and grade were greatly reduced with late applications of high rates of nitrogen. When nitrogen was applied 24 days after emergence, the 240- and 320-pound rates reduced the percentage of No. 1 potatoes, but not the total yield. When these rates were applied 55 days after emergence, both yield and grade were drastically reduced.
4. For nitrogen, the most economical procedure was to apply 160 pounds per acre within 24 days after the plants emerged.

Wash. State U. Ext. Serv., Pullman, Wash.

Welch, F., and Adams, W. E. DIVERTED FARMLAND CAN BE REPLACED BY SUBSTITUTING NITROGEN FOR ACRES. Ga. Agr. Res. 4(3): 8-9. 1963.

Two experiments were conducted at the Southern Piedmont Soil Conservation Field Station, Watkinsville, Ga., where different rates of nitrogen were added to Coastal Bermudagrass and corn.

The extent to which nitrogen can substitute for land depends on the yield response of the crop to nitrogen. Figures 1 and 2 show yields of Coastal Bermudagrass and corn with different rates of added nitrogen. Both crops gave increased yields as the rate of nitrogen increased. In the case of Coastal, yields ranged from 2.66 tons per acre with no added nitrogen to 7.48 tons per acre with 400 pounds of added nitrogen per acre. Yields of corn were 37.6 bushels per acre with no added nitrogen and 103.7 bushels per acre with 240 pounds of added nitrogen per acre. The yield increase, of both crops, per unit of N decreased as the rate of N increased.

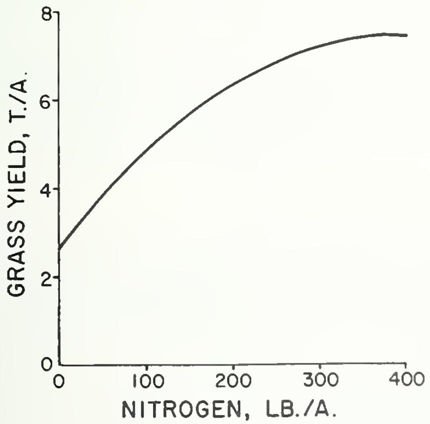

Figure 1. Yield of Coastal bermudagrass at different rates of nitrogen.

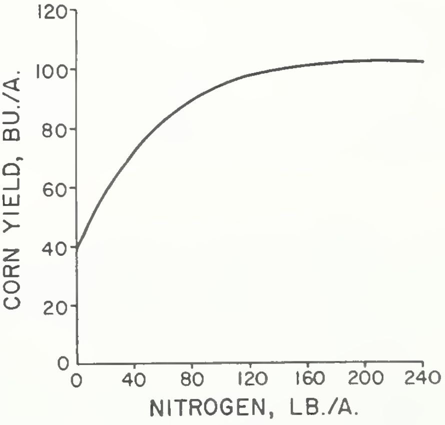

Figure 2. Yield of corn at different rates of nitrogen.

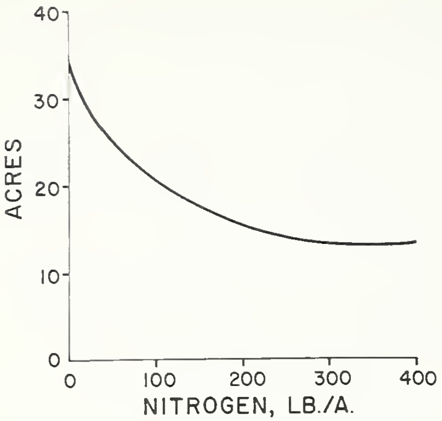

Figure 3. Acres of land required to produce 100 tons of Coastal bermudagrass at different nitrogen rates.

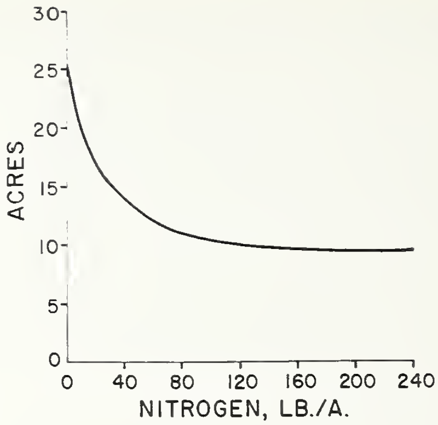

Figure 4. Acres of land required to produce 1,000 bushels of corn at different nitrogen rates.

SWCRD, ARS, USDA, Watkinsville, Ga., 30677

Cady, F. B., and Bartholomew, W. V. INVESTIGATIONS OF NITRIC OXIDE REACTIONS IN SOILS. Soil Sci. Soc. Amer. Proc. 27: 546-549. 1963.

The equilibrium reaction between NO (nitric oxide) and nongaseous compounds in the denitrification process was studied. Increments of NO were added to or removed from denitrification systems during the course of incubation.

Nitric oxide rapidly equilibrates isotopically with nongaseous products during the early stages of denitrification. Under acid soil conditions, NO appeared in the gaseous phase. Under basic soil conditions, NO did not appear from denitrification reactions but added NO persisted in the system and isotopically equilibrated with the nongaseous products in the soil. The equilibrium reactions between NO and the nongaseous compounds in the denitrification system could not be adequately explained by the conventional equation $3NO_2^- + 3H \overset{+}{\rightleftharpoons} NO_3^- + H^+ + 2NO + H_2O$. The hypothesis was advanced that other reactions and products were involved.

Iowa State U., Ames, Iowa.

Allison, F. E., Murphy, R. M., and Klein, C. J. NITROGEN REQUIREMENTS FOR THE DECOMPOSITION OF VARIOUS KINDS OF FINELY GROUND WOODS IN SOIL. Soil Sci. 96: 187-190. 1963.

The nitrogen requirements in the decomposition of 28 species of wood under laboratory conditions ranged between 0.3 and 1.4 percent of the weight of the woods, and averaged 0.8 percent. The values for 9 hardwoods were between 1.14 and 1.4 percent, whereas the values for 19 softwoods were between 0.3 and 1.3 percent, and averaged 0.6 percent. Shortleaf pine was the only softwood that required more than 0.9 percent nitrogen. The correlation coefficient between CO_2 formation during the first 2 months and maximum observed nitrogen immobilization was 0.93.

U.S. Soils Lab., SWCRD, ARS, USDA, Beltsville, Md., 20705

Court, M. N., Dickins, J. C., Stephen, R. C., and Waid, J. S. THE INFLUENCE OF SOIL TYPE ON THE RESPONSE OF MAIZE TO UREA IN GLASSHOUSE EXPERIMENTS. J. Soil Sci. 14: 247-255. 1963.

A greenhouse experiment compared the effects of ammonium nitrate and urea (1-percent biuret), applied to 42 soils, on the growth and yield of maize foliage.

Dry-matter yields of maize in most soils were similar when both sources supplied 0.15 g. or 0.30 g. N per pot. At 0.45 g. N per pot, plants in soils with urea yielded less than with ammonium nitrate in 16 soils. At 0.60 g. N per pot, plants in soils with urea yielded less than with ammonium nitrate in 19 soils. Urea adversely affected plant development to a greater extent in light soils than in heavy soils and peats. A partial correlation analysis indicated that responses to urea at the two higher rates of application were positively correlated with ammonia absorption capacity and a correlation with clay content was indicated. No significant partial correlations were obtained with organic-matter content, pH, exchangeable-hydrogen, cation-exchange capacity, and moisture content.

Serere Expt. Sta., P. O. Soroti, Uganda, Africa.

Stephen, R. C., and Waid, J. S. POT EXPERIMENTS ON UREA AS A FERTILIZER: II. THE INFLUENCE OF OTHER FERTILIZER CONSTITUENTS ON THE RESPONSE OF MAIZE TO UREA. Plant and Soil 19: 97-105. 1963.

The inefficiency of base-dressing applications of urea relative to ammonium nitrate was examined in a series of pot experiments using a sandy-loam soil (pH 7.4) and maize as a test crop. The results demonstrated that:

1. Urea and ammonium nitrate at lower rates of application gave similar yields. At higher rates, yields from urea were generally less and never more than those from ammonium nitrate partly because urea-induced damage killed established plants. The adverse effects of urea were greater when placed near the seed than when mixed throughout the soil.
2. The adverse effects of urea were alleviated by the addition of phosphorus sources with relatively high hydrogen-ion contents such as phosphoric acid and superphosphate. The alleviation was directly attributable to the supply of hydrogen ion. The effect of addition of phosphorus was purely nutritional. The phosphorus sources were more effective at higher rates of application and when placed near the seed.
3. The effect of potassium appeared to be wholly nutritional.

U. Hong Kong, Hong Kong, China.

Eckert, R. E., Jr., and Evans, R. A. RESPONSES OF DOWNY BROME AND CRESTED WHEATGRASS TO NITROGEN AND PHOSPHORUS IN NUTRIENT SOLUTION. Weeds. 11: 170-174. 1963.

In a "closed system" nutrient solution experiment, shoot growth of downy brome (Bromus tectorus L.) was: (1) More rapid during early growth; (2) accelerated earlier by nitrogen; and (3) increased more by low to intermediate levels of nitrogen than that of crested wheatgrass (Agropyron desertorum Fisch. ex Link). Shoot growth of crested wheatgrass was increased more by high levels of nitrogen and at a more mature stage of growth than that of downy brome. Root growth of crested wheatgrass was greater at all nitrogen levels than that of downy brome and was increased by the high nitrogen levels. Downy brome removed more nitrogen from solution at the intermediate nitrogen level than did crested wheatgrass and more phosphorus at both the low and intermediate nitrogen levels. At the highest nitrogen level, crested wheatgrass removed more nitrogen from solution than did downy brome.

Differences in shoot and root growth and nutrient uptake of the two species in response to nitrogen and phosphorus levels suggested some of the possibilities and limitations of manipulating growth of crested wheatgrass through fertilization to favor its establishment and growth in relation to environmental factors and competition from downy brome.

Field studies will be needed to evaluate the responses of species to fertilizer application under range conditions and to test some of the hypotheses suggested.

CRD, ARS, USDA, Reno. Nevada.

Mattingly, G. E. G., and Widdowson, F. V. RESIDUAL VALUE OF SUPERPHOSPHATE AND ROCK PHOSPHATE ON AN ACID SOIL: I. YIELDS AND PHOSPHORUS UPTAKES IN THE FIELD. J. Agr. Sci. 60: 399-407. 1963.

A field experiment on an acid soil long in arable cropping at Rothamsted measured residual effects of superphosphate, applied at several rates, and Gafsa rock phosphate applied at a single rate. Residues were valued after 1 year with barley, and after 2 years with ryegrass. In each year, the value of the residues was related to yields from fresh superphosphate dressings taken as standards. 'Percentage fresh superphosphate equivalents' of the residues were determined using yields and P uptakes of both crops. An isotope dilution method with P-32 was also used with barley. The experiment was continued for 2 further years without applying phosphate fertilizers, to measure yields and P uptakes from the residues and yields and P uptakes from rock phosphate relative to superphosphate.

'Percentage fresh superphosphate equivalents' of residues of superphosphate for barley varied with the growth of the crop and with the method used to calculate them. They were 21 to 24 percent 6 weeks after sowing, measured from yield, P uptake, or isotope dilution. At harvest, they were 26 percent from yield, 43 percent from P uptake, and 49 percent by isotope dilution. 'Percentage fresh superphosphate equivalents' 6 weeks after sowing increased with the rate of superphosphate but at harvest were independent of rate. 'Percentage superphosphate equivalents' of Gafsa rock phosphate were much smaller; they increased from 2 to 3 percent 6 weeks after sowing to 7 to 12 percent at harvest.

With ryegrass 'percentage fresh superphosphate equivalents' of residues of superphosphate applied either 1 or 2 years previously also varied with growth. All methods of valuation showed that residues were about twice as effective after 1 year as after 2 years in the soil. 'Percentage fresh superphosphate equivalents' derived from P uptake remained constant during growth and were 37 to 38 percent for superphosphate applied 1 year before and 18 to 20 percent for superphosphate applied 2 years before. Values derived from rye-grass yields decreased during growth from 76 to 45 percent (1-year residues) and from 38 to 21 percent (2-year residues).

After cropping with barley for 2 more years, there was little difference between yields or P uptakes from equal amounts of superphosphate whether applied 3 or 4 years previously. Residues from rock phosphate were almost equivalent to those from superphosphate after 3 to 4 years.

Apparent recoveries of superphosphate, as percentage of the amount applied, decreased with rate. The apparent recovery of P by crops in 5 years was about 21 percent from superphosphate and about 10 percent from rock phosphate when both were applied at 300 lbs. P_2O_5 per acre.

Rothamsted Expt. Sta., Harpenden, Hertfordshire, England.

Burns, G. R., Bouldin, D. R., Black, C. A., and Hill, W. L. ESTIMATION OF PARTICLE-SIZE EFFECTS OF WATER-SOLUBLE PHOSPHATE FERTILIZER IN VARIOUS SOILS. Soil Sci. Soc. Amer. Proc. 27: 556-560. 1963.

A laboratory method was developed for estimating the relative availabilities to plants of the P applied to soil in fertilizer particles differing in size. The method was based on the concept that the total availability of fertilizer P applied in particles of a given size is equal to the produce of: (1) The number of particles of that size; and (2) the summation of the availabilities of fertilizer P in the hypothetical small volumes of soil affected by a single particle.

The method was applied experimentally to $NaH_2PO_4.H_2O$ particles of three sizes in each of six soils. Appropriate quantities of a concentrated solution of P-32 tagged NaH_2PO_4 were used to stimulate the effects of fertilizer particles of different sizes, and particles of anion-exchange resin were used to provide indexes of availability of fertilizer P in segments of the soil affected by one fertilizer particle. These values were integrated to obtain an index of total availability of fertilizer P. The indexes of total availability obtained from the laboratory data were in qualitative agreement with the relative availabilities of fertilizer P to plants in five of the six soils tested.

SWCRD, ARS, USDA, Beltsville, Md., 20705

Caldwell, A. C., and Kline, J. R. EFFECT OF VARIOUSLY SOLUBLE POTASSIUM FERTILIZERS ON YIELD AND COMPOSITION OF SOME CROP PLANTS. Agron. J. 55: 542-545. 1963.

Slowly soluble potassium-bearing fertilizers were compared with KCl as sources of K in three experiments. The use of slowly soluble K fertilizers did not restrict luxury consumption of K by plants when used at practical rates. The various soluble K sources were apparently equivalent to KCl with respect to yields of corn and alfalfa obtained at various rates of application. The slowly soluble potassium fertilizers caused significantly less salt damage than KCl to flax seedlings when these materials were applied with the seeds at rates up to 415 pounds of K per acre.

U. Minn., St. Paul, Minn.

Hunt, O. J., and Wagner, R. E. EFFECTS OF PHOSPHORUS AND POTASSIUM FERTILIZERS ON THE YIELD AND BOTANICAL AND CHEMICAL COMPOSITION OF SEVEN GRASS-LEGUME MIXTURES. U.S. Dept. Agr., Agr. Res. Serv. ARS 34-45. 37 pp. 1963.

The effects of rates and ratios of phosphorus and potassium fertilizers and lime levels on forage yield and botanical and chemical composition of seven grass-legume mixtures were studied over a 3-year period.

Potassium fertilization produced the greatest yield response in all the forage mixtures. It was necessary to apply 100 to 300 pounds of K_20 per acre to maintain good yields of the mixtures. Smooth brome and alfalfa showed the most outstanding response to potassium. There was very little residual effect from the application of high rates of potassium the first year only.

Phosphate needs appeared to be satisfied with the application of 150 pounds of P_20_5 per acre at seeding or about 50 pounds per acre annually.

The most striking response to lime level was shown by the smooth brome and alfalfa mixture. Alfalfa was eliminated almost completely from the mixture during the first season at low-lime levels. The orchardgrass and birdsfoot trefoil mixture was the only one that showed a consistent favorable response to low-lime levels.

The balance of legumes and grasses changed considerably during the 3 years of the study. Potassium application maintained the percentage of legumes at a higher level. The legume percentage in plots fertilized at the lower rates of potassium or with high rates the first year only began to decline rapidly after the first year. Yields decreased generally as the proportion of legumes decreased.

The potassium and phosphorus content of the forage varied in general with the amount of the elements applied. Grasses were generally higher in potassium content than legumes except at the highest rates of potassium application. Ladino clover contained more potassium than alfalfa or birdsfoot trefoil. The critical level of potassium would appear to be from 1.75 to 2.25 percent for alfalfa and birdsfoot trefoil and about 2.5 percent for ladino clover. The grasses should contain about 2.5 to 3.0 percent potassium for good production.

The K/(Ca + Mg) equivalent ratios usually were lower than 2.5 in the combined grass and legume forage. Orchardgrass alone at high rates of potash fertilization would contain ratios in excess of 2.5.

Data on the content of other major and minor elements in individual grass and legume species were presented.

Tables.

ARS, USDA, Inform. Div., Rm. 645A FCB, Hyattsville, Md., 20781

Elliot, J. M., and Back, M. E. EFFECTS OF POTASSIUM AND CHLORINE ON THE PRODUCTION OF TOBACCO SEEDLINGS. Canad. J. Soil Sci. 43: 268-274. 1963.

In a tobacco greenhouse experiment, potassium was applied to a muck layer at 3.32, 6.64, 9.96, 13.28, and 16.60 pounds, with and without 3 pounds of chlorine, per 900 square feet. A check treatment received no potassium or chlorine. Greatest total dry weight per plot and highest rate of survival of seedlings in the field was obtained with the 3.32-pound rate of potassium with or without chlorine; dry weight of tops, height of plant, leaf area, and total dry weight per plot tended to decrease with each increment of potassium above 3.32 pounds. High levels of applied potassium increased soluble salts in the muck to a level which retarded plant growth. Apparently the muck was capable of releasing large amounts of potassium for plant growth as more potassium was taken up by the plants than was supplied by the 3.32-pound rate. Chlorine in the fertilizer increased the total ash and potassium content of the seedlings but tended to decrease the nitrogen. Potassium and chlorine had no effect on the weight of roots and relative turgidity of the plants.

Canada Dept. Agr., Delhi, Ontario, Canada.

Stritzel, J. A. YOU HAVE A CHOICE OF FERTILIZER RATES. Iowa Farm Sci. 17 (12): 14-16. 1963.

Many farmers and fertilizer dealers aren't aware that more than one profitable fertilizer rate is available for each soil-test value shown for a given soil sample. More than one profitable rate exists as long as the added fertilizer and application costs are less than the added value of the crop yield increases produced.

The application of successive, equal additions of a fertilizer nutrient to a crop growing on a soil that's deficient in that nutrient usually results in yield increases, quality increases, or increases in some other desirable characteristic. Increased yield from fertilizer varies with the adequacy or inadequacy of the other controllable factors that also influence crop yields.

Soil tests measure the nutrient-supplying power of a soil. But the test values don't, by themselves, indicate how much of a given nutrient should be added to the soil tested. The amount of a nutrient to add can be determined only by conducting long-time fertilizer-rate experiments with each important crop grown on major soils of the state.

The response curves that are based on the results of these field experiments indicate the nutrient rates necessary to obtain certain average yields, for different management levels and for the soil-test values concerned. The profitability of different fertilizer rates was determined by economic analysis of the field experiment data.

Iowa State U. Sci. and Tech., Ames, Iowa.

Calder, F. W., and Langille, W. M. TRACE ELEMENT EFFECTS ON OATS AND ALFALFA GROWN ON THREE SOILS. Canad. J. Plant Sci. 43: 482-489. 1963.

Oats followed by alfalfa were grown in the greenhouse on three soil types that were limed at three levels and received treatments of 20, 40, 60, and 100 pounds of B; 4, 16, and 64 ounces of Mo; and 20 and 60 pounds per acre of S. Yield and growth characteristics of the plants were recorded, content of B, Mo, S, Co, and Zn in plant tissue was determined. Oats were much more sensitive to excessive amounts of B than alfalfa. The yield of oats on unlimed and on soil limed to pH of 6.2 decreased consistently with increasing rates of B. At the highest liming rate, a decrease in yield resulted with a B application of 40 pounds or more per acre. Sixty pounds per acre of B did not reduce the yield of alfalfa, but there was a significant reduction in yield at 100 pounds per acre. Toxic effects, as indicated by chlorosis of the leaves, were much more marked at the low pH levels. Effects of pH level on uptake of the trace elements and effect of Mo and S on B uptake were shown and discussed.

Expt. Farm, Res, Br., Canada Dept. Agr., Nappan, Nova Scotia, Canada.

Hunter, A. S., Kinney, H., Whittaker, C. W., Axley, J. H., Peech, M., and Steckel, J. E. A COLLABORATIVE STUDY OF THE ETHYLENEDIAMINETETRAACETATE (EDTA) METHOD FOR RATING AGRICULTURAL LIMESTONES: I. REPRODUCTIBILITY OF RATINGS AND CORRELATIONS WITH CHEMICAL AND PHYSICAL CHARACTERISTICS OF MATERIALS. Agron. J. 55: 351-354. 1963.

The method of rating limestones by their reaction with EDTA proposed by El Gibaly and Axley (1955), was employed in 12 cooperating laboratories, on uniform samples of 34 ground limestones and 5 other liming materials. Important chemical and physical characteristics of the 39 materials were determined. The ratings obtained by the cooperators were subjected to analysis of variance. Correlation coefficients relating EDTA ratings and several chemical and physical characteristics of the limestones were calculated.

Analyses of variance of the ratings of 33 limestone samples by 12 cooperators indicated that there were significant differences in ratings between materials and between laboratories. It was considered that the variations in ratings were such as might be expected among laboratories where technicians were using an unfamiliar chemical technique for the first time, and that they would probably become smaller with additional use. Mean EDTA ratings were positively and significantly or highly significantly correlated with percentages of $CaCO_3$, percentages of material passing 60-, 100-, and 200-mesh sieves, and pH of suspensions when limestones, soil, and water were shaken together for 100 minutes. The correlation between EDTA ratings and percentages of $MgCO_3$ were highly significant and negative. Degree of fineness affected the EDTA rating to a lesser extent than percentage $CaCO_3$ or $MgCO_3$. The pH of soil and limestone suspensions was positively correlated with percentage $CaCO_3$ and negatively correlated with percentage $MgCO_3$; both correlations were highly significant.

It was concluded that the El Gibaly and Axley EDTA method for evaluating the reactivity of limestones holds considerable promise and warrants further investigations.

Pa. Agr. Expt. Sta. University Park, Pa.

Whittaker, C. W., Axley, J. H., Peech, M., Steckel, J. E., McLean, E. O., and Hunter, A. S. A COLLABORATIVE STUDY OF THE ETHYLENEDIAMINETETRAACETATE (EDTA) METHOD FOR RATING AGRICULTURAL LIMESTONES: II. RELATIONSHIPS OF RATINGS AND OF CALCIUM CARBONATE CONTENT OF LIMESTONES TO THEIR REACTIVITY IN THE SOIL. Agron. J. 55: 355-358. 1963.

Twelve representative agricultural limestones were each incubated with 12 soils and the resulting soil pH in water and in 0.01$\underline{M}$ $CaCl_2$ was determined at intervals. Amount of limestone decomposed was determined in some cases. The pH values and the amount of limestone decomposed (or lime requirement after incubation) were highly correlated with activity ratings of the limestones by two EDTA reagents and with the percent $CaCO_3$ in the limestone. Much of the variation in the reactivity of the limestones in soils was, however, not accounted for by the ratings or by the percent $CaCO_3$. It should be possible to find a reagent and technique that will more accurately predict limestone reactivity. Soil pH values determined in water or in 0.01$\underline{M}$ $CaCl_2$ were equally useful.

SWCRD, ARS, USDA, Beltsville, Md., 20705

MacLeod, L. B., and Bradfield, R. EFFECT OF LIMING AND POTASSIUM FERTILIZATION ON THE YIELD AND COMPOSITION OF AN ALFALFA-ORCHARDGRASS ASSOCIATION. Agron. J. 55: 435-439. 1963.

Oats and 7 crops of a competitive alfalfa-orchardgrass mixture were grown in the greenhouse on Mardin sil (pH 4.8) limed at rates of 1.0, 2.3, 4.0 and 5.6 tons $CaCO_3$ equivalent per acre with calcite and dolomite and fertilized at rates of 0, 100, and 300 pounds of K per acre. Honeoye sil, a high lime soil (pH 7.0), was included for comparative purposes. Dolomite gave higher yields than calcite, particularly where K supply was limiting. Response to applied K increased markedly with increased base saturation of the soil. Survival of alfalfa plants on soil limed to pH 5.5 or higher appeared to be largely dependent on K fertilization. Alfalfa was the dominant species where there was sufficient K for both components and orchardgrass dominated where K was limited. Percent total available carbohydrates in the storage organs of each species were increased by K fertilization.

It was indicated that K nutrition was a critical factor in determining yield and survival of legumes particularly at high rates of liming. Liming to a pH of 5.5 appeared to be adequate for oats and to a pH of 5.8 to 6.0 for both alfalfa and orchardgrass. When the soil pH was in excess of 6.0, the need for K fertilization increased.

The practical implications of these findings to forage crop production on acid soils lie in the promotion of a moderate liming program designed to bring larger areas of soil to a pH of 5.5 to 6.0. If limed to a pH above 6.0, further yield increases will be largely dependent on K supply. A high K fertilizer should be recommended for maintenance of the legume component in grass-legume associations. Dolomitic limestone was recommended over calcitic, especially where high rates are applied and where the native supply of Mg in the soils is low.

Canada Expt. Farm, Canada Dept. Agr., Nappan, Nova Scotia, Canada.

Reith, J. W. S., and Inkson, R. H. E. EFFECTS OF FERTILIZERS AND FARMYARD MANURE ON SWEDES AND TURNIPS. J. Agr. Sci. 60: 145-157. 1963.

Thirty-eight experiments on swedes and turnips, using factorial designs without replication, were made to measure the responses and two-factor interactions produced by applying nitrogen, phosphorus, and potassium. The effect of F.Y.M. was measured at 14 of the centers.

The yield of tops was substantially increased by nitrogen. Phosphorus produced a moderate response but potassium had practically no effect on top growth.

The yield of roots showed small to moderately large responses to nitrogen in most experiments. There was a considerable variation in the rate required to produce the largest response, depending on the previous cropping of the field.

Phosphorus increased the yield of roots in all but four of the experiments and this nutrient generally had a greater effect than either nitrogen or potassium.

The response to potassium was significant in only half of the experiments and its effect on yield was normally less than that of nitrogen.

The two-factor interactions were practically without exception small and far from significant, the highest values usually occurred on responsive soils. The means showed no interaction between nitrogen and phosphorus, and small positive interactions between nitrogen and potassium and between phosphorus and potassium.

F.Y.M. produced higher yields at the majority of the centers but had very little effect at some. At suboptimal P_2O_5 levels, F.Y.M. tended to increase the response to nitrogen, but with adequate phosphorus this manure reduced the most profitable nitrogen rate. The response to phosphorus was markedly reduced by placing F.Y.M. in the bottom of the ridges but the effect of plowing in this manure during autumn or early winter on the phosphorus response was very small. In all experiments, F.Y.M. produced a substantial reduction in the response to potassium.

As a result of the inadequate phosphorus rates, these experiments did not provide satisfactory estimates of the amounts of nutrients supplied by F.Y.M. but suggested that 15 tons per acre supplied at least 15 lb. N, 15 lb. P_2O_5, and 70 lb. K_2O to the first crop grown after application.

The mineral composition of the roots showed large variations between crops grown on different soils. The application of a nutrient generally produced a small increase in its percentage in the roots. The nutrient uptakes showed a much greater apparent recovery of both nitrogen and potassium than of phosphorus.

The most profitable nutrient dressings were calculated from these experiments. At current prices, about 65 lb. N, 125 lb. P_2O_5, and 125 lb. K_2O should be about the average optimal rates per acre in the absence of F.Y.M. In the presence of a normal dressing of the F.Y.M., suitable optimal rates were about 50 lb. N, 110 lb. P_2O_5, and 55 lb. K_2O.

Macaulay Inst. Soil Res., Aberdeen, Scotland.

Widdowson, F. V., Penny, A., and Cooke, G. W. RESULTS OF AN EXPERIMENT AT ROTHAMSTED TESTING FARMYARD MANURE AND N, P, AND K FERTILIZERS ON FIVE ARABLE CROPS: I. YIELDS. J. Agr. Sci. 60: 347-352. 1963.

A rotation experiment was started at Rothamsted in 1956 on a field where grass had grown for many years. The soil contained very little HCl-soluble P and K but much N. The soil had been acid, but was limed to pH 6.5 immediately before the experiment started; this pH was maintained. Very small individual plots (0.00128 acre) were used and nearly all work was done by hand. The results showed that such small plots can be used to do complicated rotation experiments satisfactorily provided that all work is done carefully and movement of soil over plot boundaries is prevented.

Responses to combinations of N, P, and K fertilizers and farmyard manure (FYM) were measured on wheat, kale, barley, grass-clover ley, and potatoes grown in rotation. Two rates of N were tested. A strip of permanent grass had the same treatments as the arable crops.

Winter wheat yielded most dry matter, but wheat yields were increased least, proportionally, by added nutrients. Potatoes gave the smallest yield without manure and responded most to nutrients, yields being increased almost sixfold by NPK fertilizer plus FYM. Kale, barley, and grass-clover ley were intermediate in their unmanured yields and in their responses.

All crops except the grass-clover ley responded to N; kale responded most and wheat least. Potatoes, kale, and barley responded roughly equally to P and needed this nutrient more than did wheat and the ley. Potatoes responded most to K, yields of wheat and clover ley were also small without K, but barley and kale needed K less. Interactions between nutrients were large with most crops, particularly with N on kale and K on potatoes, wheat, and clover.

FYM greatly increased yields of all crops but responses were less when fertilizers were also given. Potatoes responded most to FYM whether or not fertilizers were also used. FYM also caused large increases in yields of grass-clover ley, kale, and permanent grass.

Rothamsted Expt. Sta., Harpenden, Hertfordshire, England.

Bunting, A. H. EXPERIMENTS ON ORGANIC MANURES, 1942-49. J. Agr. Sci. 60: 121-140. 1963.

Comparative information from 113 experiments on 56 sites in England during 8 years, on the composition and agronomic effects of farmyard manure, sewage sludge and composts of straw with sewage sludge or inorganic-N sources, and on the effects of straw plowed in with sludge or inorganic-N sources was given.

The field experiments were almost all of factorial design, testing two or more manures, usually at two rates of dressing, with and without applications of fertilizers supplying nitrogen, phosphate, and potash. Where one of these three nutrients was not included in the factorial design, it was applied to all plots as a basal dressing. The rates of application were 8 and 16 tons of strawy manures and 5 and 10 tons sludge dry matter per acre for farm crops. For horticultural crops these rates were doubled.

Sewage sludge was little more than a source of nitrogen and phosphate. Some sludges contained heavy metals from industrial wastes, which were either harmful to crops or decreased the availability of phosphate. The usefulness of sludges free from these disadvantages was largely a matter of cost, but their deficiency in potash must be corrected, especially on K sensitive crops. Where sludge was used at 5-10 tons dry matter per acre there was usually no useful response to N fertilizer. A well-rotted straw-sludge compost, applied at around 30 tons per acre, approached a similar quantity of farmyard manure in its effect on crop yield. It supplied nitrogen, phosphate, and some potash. Farmyard manure was the best of the three. Composts of straw with inorganic nitrogen sources did not appear useful.

Rothamsted Expt. Sta., Harpenden, Hertfordshire, England.

Salinity and Alkali Problems

Ferguson, W. S., and Hedlin, R. A. EFFECT OF SOLUBLE SALTS ON PLANT RESPONSE TO AND ABSORPTION OF PHOSPHORUS. Canad. J. Soil Sci. 43: 210-218. 1963.

Fertilizer experiments indicated that much higher plant response to phosphorus occurred on moderately saline than on non-saline soil. Soil analyses showed that this difference could not be explained by the amount of sodium bicarbonate extractable phosphorus contained in these two soils.

Greenhouse experiments with artificially salinized soil indicated that the uptake of phosphorus by barley plants was related to the salt concentration in the soil. Phosphorus absorption increased with increasing salt concentration, reached a maximum when the saturation soil extract measured approximately 6 millimhos, and then declined with further increases in salt concentration. This relationship was similar for fertilized and unfertilized plants. However, the increase in phosphorus absorption was much greater when phosphorus fertilizer was applied.

This same relationship between salt concentration and phosphorus absorption was obtained with increasing NaCl concentration in liquid cultures. Maximum phosphorus absorption by barley occurred when the solution contained between 0.05 and 0.10 molar NaCl. This relationship was attributed to the effect of salts on the physiology of the plant rather than the effect of salts on phosphorus solubility.

Canada Dept. Agr., Brandon, Manitoba, Canada.

Halsey, D. D., Spencer, J. R., Branson, R. L., and Marsh, A. W. VINEYARD SALINITY PROBLEMS: CORRECTED WITH SPECIAL LEACHING IN COACHELLA VALLEY TRIALS. Calif. Agr. 17(5): 2-3. 1963.

Annual leaching with heavy water applications by ponding, with the aid of plastic levees, or use of sprinklers, may be the answer to problems of excess salt accumulation in Coachella Valley vineyards. Trials in a Thompson Seedless vineyard showed marked improvement in vine condition following these special leaching practices. Previous installations of additional tile drains had not corrected this vineyard salinity problem. Salt accumulation in the soil, with resulting vine decline, is the most important current problem facing grape growers in the Coachella Valley.

Farm Advisor, Riverside County, Calif.

Williamson, R. E. THE MANAGEMENT OF SOIL SALINITY IN LYSIMETERS. Soil Sci. Soc. Amer. Proc. 27: 580-583. 1963.

Soil salinity quickly became a problem in sheltered lysimeters used for studies of the drainage requirements of crops in North Carolina. Water tables were maintained by subsurface watering at depths of 6 to 40 inches below the soil surface in 3-foot-square lysimeters, with some sheltered from rainfall and others exposed to rainfall. All were exposed alike to other atmospheric conditions. Very high levels of P, K, and Ca were established in the soil by mixing 0-20-0, muriate of potash, and lime with the soil placed into each tank.

Soybean plants exhibited chlorosis and stunted growth in the lysimeters with subsurface watering only. These symptoms were serious approximately 1 month after the establishment of water tables only 6 inches beneath the surface, but were less pronounced with the deeper water tables. They were not observed where rain fell on the soil.

At any water table depth, the plant growth and yield were best on the lysimeters that were leached with rainfall. Plant growth increased with depth to water table to a depth of 24 inches, both with and without rain on the soil.

After soybean harvest in 1959, the electrical conductivity of the saturation extract from the soil in the top 6 inches of all lysimeters was 4 to 5 millimhos. where subsurface watering only was used, and 0.4 millimho. where rain fell on the soil.

Lower fertilizer applications and leaching with small amounts of water kept the soil salinity in the upper 6-inches at a low level in subsequent years. Crops of soybeans, cabbage, corn, grain sorghum, and string beans were produced successfully both in the lysimeters sheltered from rain and in those exposed to rain.

SWCRD, ARS, USDA, Raleigh, N.C., 27607

Climatic Influences

McGuinness, J. L. ACCURACY OF ESTIMATING WATERSHED MEAN RAINFALL. J. Geophysical Res. 68: 4763-4767. 1963.

The average error of determining mean rainfall on watersheds of 7.16 mi.^{2} and less was related to rain amount and gaging ratio. The results were combined with previous analyses and a nomogram was presented to facilitate estimates of error for gaging ratios of 0.1 to 1000 mi.^{2} per gage over a range of rainfall amounts and geographic locations in the Middle West. The possibility of further generalization of the results was discussed.

SWCRD, ARS, USDA, Coshocton, Ohio. 43812

Allis, J. A., Harris, B., and Sharp, A. L. A COMPARISON OF PERFORMANCE OF FIVE RAIN-GAGE INSTALLATIONS. J. Geophysical Res. 68: 4723-4729. 1963.

The daily rain, snow, or mixed-rain-and-snow catch by five different rain-gage installations was measured near Hastings, Nebr., during the period January 1946 through September 1961. Rain-gage installations included were a U.S. Weather Bureau standard 8-inch gage, a weighing-recording gage, a standard gage on a 6-foot post, a standard gage equipped with an Alter shield, and a standard gage equipped with a Niper shield. The shielded gages caught slightly more precipitation (significant at 1-percent level) than the unshielded gages. When rainstorms were divided into 0.5-inch increments, the performance of the five different rain gages was not consistent. Some of the differences were statistically significant. The differences in performance of the several gages were so small that they have no practical significance. True precipitation was unknown.

A. L. Sharp, SWCRD, ARS, USDA, West Linn, Oreg.

Miller, J. F. TECHNICAL PAPER NO. 47 PROBABLE MAXIMUM PRECIPITATION AND RAINFALL-FREQUENCY DATA FOR ALASKA FOR AREAS TO 400 SQUARE MILES, DURATIONS TO 24 HOURS AND RETURN PERIODS FROM 1 TO 100 YEARS. U.S. Weather Bur. Tech. Paper 47, 69 pp. $1.00, 1963.

This report was prepared for the Soil Conservation Service to provide generalized rainfall information for planning and design purposes in connection with its Watershed Protection and Flood Prevention Program.

Rainfall data for various hydrologic design problems involving areas up to 400 sq. mi. and durations up to 24 hours were presented. The data consisted of generalized estimates of: (1) Probable maximum precipitation (PMP); and (2) rainfall-intensity-frequency data for return periods from 1 to 100 years.

For sale by Supt. Doc., U.S. Govt. Printing Off., Washington, D.C., 20402

Henderson, F. M. SOME PROPERTIES OF THE UNIT HYDROGRAPH. J. Geophysical Res. 68: 4785-4793. 1963.

The instantaneous unit hydrograph and the properties connecting it with the unit hydrograph for a rainfall excess of any finite duration were used to explore the relationship between the peak flow of a unit hydrograph and the duration of rainfall excess from which it arises. This relationship was found to be substantially independent of the skew or any other shape factor of the instantaneous unit hydrograph and dependent only in its base width, provided that this base width was properly defined. It was strongly dependent on the distribution of rainfall excess intensity over the duration of the storm. Some comments were made on the significance of these results for the designer seeking an estimate of the peak discharge; in particular it was suggested that a one-parameter description of the instantaneous unit hydrograph may be sufficient.

U. Canterbury, Christchurch, New Zealand.

Rosenberg, N. J., Felch, R. E., and Bagley, W. T. WIND BARRIER-INDUCED MICROCLIMATE AND ITS EFFECTS ON THE GROWTH AND PHENOLOGICAL DEVELOPMENT OF AN IRRIGATED BEAN CROP. Preliminary Rpt. U.S. Weather Bur. Contract No. CWB-10428. 63 pp. 1963.

Dry beans were grown within a 50 x 50 foot square, enclosed with a double tier of snow fence, at Scotts Bluff, Nebr., during the summer of 1962. Microclimate was monitored above and within the plant canopy of the wind-sheltered beans and similarly in an exposed control plot. Air temperature, dew point temperature, air movement, net radiation, and soil temperature at two depths were recorded for 5 minutes on the half-hour, continuously, for a period of 50 days. A record of daily evaporation from black and white Bellani plate atmometers and mercury-manometer tensiometers was obtained. Plant height, leaf number and area, flowering characteristics and pod set, and yield and maturity of the beans were sampled in a manner permitting comparison between the sheltered and the controlled plot and between north-south oriented sections within the shelter.

Microclimate was altered significantly in a very short time after erection of the barrier with the air temperatures, soil temperatures, and humidity higher in the sheltered plot. These same differences were maintained throughout the season with mean air temperature above the canopy being about 2.5° C. higher and mean vapor pressure of water being almost 3 mbar higher in the sheltered plot.

Wind velocity as measured with 3-cup anemometers was reduced to about 16 percent of outside value. "Air movement" (3-dimensional) measured with thermocouple anemometers was reduced by only one third.

Seasonal receipts of net radiation were reduced by 10 percent within the canopy of plants growing in the shelter. Maximal transmission (or minimal utilization) of net radiation within the canopy occurred in the sheltered plot in mid morning. Maximal transmission in the exposed area occurred in the afternoon.

Air temperatures were generally higher around the clock above and within the canopy of the sheltered plot.

Air temperature gradients within plots were such that heat flux into the soil should be greater in the shelter during the daytime and outward flux at night should be approximately equal that in the open plot.

Downward soil temperature gradients existed for possibly 1 hour longer during the day of the sheltered plot. Nighttime outward heat flux gradients were about 1/2° C. greater in the open than in the shelter.

Striking differences in humidity regimes existed between the well-watered sheltered and exposed plots. Vapor pressure was at least 2 mbars greater during the night and on the average 5 mbars greater during the day above the canopy in the sheltered plot. Nighttime differences above the canopy were minimal, but vapor pressure was usually 4 mbars greater within the canopy of the sheltered plot.

Vapor pressure deficits were greater during the daytime in the sheltered plot but were lower at night.

Two weeks after installation of the barrier, plants were taller in the sheltered plot, particularly in sections adjacent to the fence. Later, plants in the center exceeded in height those at the edges of the plot. Plants in the center ceased to grow earlier than did those at the edges.

Leaf area was greater within the shelter, particularly in the center section. Leaf number was generally greater within the shelter.

Pod set was increased by the barrier but much variation existed within the sheltered plot. Dry bean yields were significantly greater in the sheltered plot except at the very edges of that plot. Seeds were larger sized in the open plot.

Maturity was delayed in the sheltered plot and quality of the beans was superior.

Rate of growth of the plants during a specified interval was almost perfectly correlated with accumulated temperature difference between plots.

Sapping, the decreased productivity of areas immediately adjoining living windbreaks, was partly due to shading effects. A non-living windbreak resulted in decreased productivity of beans growing alongside the fence.

U. Nebr., Lincoln, Nebr.

Martin, G. C., and Wilcox, G. E. CRITICAL SOIL TEMPERATURE FOR TOMATO PLANT GROWTH. Soil Sci. Soc. Amer. Proc. 27: 565-567. 1963.

Fireball and Kokomo variety of tomatoes were used to study the effect of root temperatures at 56°, 58°, 60°, and 70° F., and of P concentration on plant growth and chemical composition. The early and late tomato varieties responded similarly to the respective root temperatures. The response to P fertilizer was between 5 and 50 p.p.m., with no further growth increase at 100 p.p.m. There was a growth increase as expressed by dry weight between 56° and 58° and 58° and 70° F., but not between 58° and 60° F. Although in all cases increasing the temperature from 56° to 58° F. increased nutrient uptake, the difference was not great enough to have any practical importance. The growth of tomato shoots was doubled by increasing the root temperature from 56° to 58° F.

ARS, USDA, Wenatchee, Wash.

Mulching

Takatori, F. H., Lippert, L. F., and Whiting, F. L. PETROLEUM MULCH AIDS GERMINATION AND STAND ESTABLISHMENT IN PRELIMINARY VEGETABLE CROP STUDIES. Calif. Agr. 17(6): 2-3. 1963.

Soil mulching materials, ranging from plant debris to synthetic plastic films, have been used for years in agriculture to manipulate soil temperature, soil moisture, and alter the physical structure of the soil. Application procedures, costs, and availability of mulching materials are critical considerations to the grower. Relatively simple handling, application, and disposal procedures possible with petroleum mulch offer definite advantages. Preliminary studies reported indicate that petroleum mulch was beneficial in promoting early germination and establishing stands in a number of vegetable species.

U. Calif., Riverside, Calif.

PLANT MANAGEMENT

Pasture and Haylands

Edmond, D. B. EFFECTS OF TREADING PERENNIAL RYEGRASS (LOLIUM PERENNE L.) AND WHITE CLOVER (TRIFOLIUM REPENS L.) PASTURES IN WINTER AND SUMMER AT TWO SOIL MOISTURE LEVELS. New Zealand J. Agr. Res. 6: 265-276. 1963.

Two uniform perennial ryegrass (Lolium perenne L.) and white clover (Trifolium repens L.) pastures, growing in a silt loam, were used (winter 1957 and summer 1958) to investigate the effects of periodical treading, where the soil was at two different soil moisture levels. Spray irrigation and mature Romney sheep were used.

All treadings, especially where the soil was wet, reduced measured herbage yields. Total yields of dry herbage in lb. per acre during winter 1957 included: Not trodden--1,980; moist soil, 18 sheep treatment--1,670; wet soil, 18 sheep--270; S.E. ± 62; and others during summer 1958 included: not trodden--2,280; moist soil, 18 sheep--1,080; wet soil, 18 sheep--230; S.E. ± 74. Perennial ryegrass was consistent in being relatively tolerant of treading, while white clover was tolerant in the summer. Thus the proportion of perennial ryegrass increased in the trodden pastures, while Poa annua L. volunteered in bare spaces.

Reduced yields appeared to be mainly due to the lower vigor of a lesser number of grass tillers in trodden pastures.

Particularly in wet soil, direct effects on plants, such as root damage, plant displacement, and burial in mud, appeared to be important. There appeared to be significant changes in the soil itself, such as limitation of soil air, indicated by gleying at 1 to 1-1/2 in. depth in winter.

Dept. Sci. and Indus. Res., Palmerston North, New Zealand.

Yarlett, L. L., and Moore, J. R. MANAGEMENT OF GULF COAST SALT MARSHES. J. Soil and Water Conserv. 18: 166-167. 1963.

Salt marshes that occur along the gulf coast of Florida have a great potential for producing native forage and for wildlife habitat and recreational facility development. Management of these salt marshes for maximum forage production would have far reaching effects on livestock production in the area.

Approximately 450,000 acres of salt marshes are found in Florida along the northwestern gulf coast. These salt marshes occur in a narrow band that varies in width from 0.25 to 4 miles and is approximately 180 miles long. Though portions of the area are subject to daily tidal action, most of it is inundated only during storms or by abnormally high tides. Salinity of the water in the marshes varies with their proximity to the mouths of rivers.

Recommended management practices for the seven common soils occurring in the coastal marshes were given.

SCS, USDA, Sebring, Fla.

Kay, B. L. EFFECTS OF 4-(2,4-DB) AND DALAPON ON THREE ANNUAL TRIFOLIUMS. Weeds 11: 195-198. 1963.

Rose clover (Trifolium hirtum All.), subterranean clover (T. subterraneum L.), and crimson clover (T. incarnatum L.) were sprayed at different growth stages with dalapon, and two formulations of 4-(2,4-DB), in two growing seasons. Herbage yields, seed yields, and seed quality were for the most part unaffected by either formulation of 4-(2,4-DB) at the dates required for weed control. Only subterranean clover was tolerant of dalapon and then only at very low rates.

U. Calif., Davis, Calif.

Evans, R. A., Kay, B. L., and McKell, C. M. HERBICIDES TO PREVENT SEED SET OR GERMINATION OF MEDUSAHEAD. Weeds 11: 273-276. 1963.

Amitrole sprayed on annual grassland infested with medusahead (Elymus caput-medusae L.) at 1/2 to 4 lb./A. when medusahead was in the boot or soft dough stage reduced viable caryopses from 60 to 100 percent, and seed production the following year from 75 to almost 100 percent. Maleic hydrazide and dalapon reduced viability of medusahead seeds but were less effective than amitrole. Viable caryopses of soft chess (Bromus mollis L.) were reduced. The year following treatment, soft chess was decreased in the stands by early application (boot stage of medusahead) but not by late application of herbicides, when the soft chess heads were dry.

Res. Range Conserv., ARS, USDA, Reno, Nev.

Rangelands

Soil Conserv. 29(1): 3-24. Aug. 1963.

This special issue of Soil Conservation was devoted to the effects of grassland conservation practices. The following articles were given:

Herting, G. C., and Stafford, I. B. WATERSHED LAND TREATMENT BOOSTS COMMUNITY INCOME. SCS, USDA, Norwich, N.Y.

Fulton, D. H. UTAH RANCHER GETS RESULTS WITH CONSERVATION PROGRAM. SCS, USDA, Roosevelt, Utah.

Tonsfeldt, W. R. REED CANARYGRASS PROTECTS IOWA WATERSHED STRUCTURES. SCS, USDA, Sioux City, Iowa.

Sisk, L. J. GRASS CHANGES THE SOUTHEAST. SCS, USDA, Spartanburg, S.C.

Tabor, P. BASAL PLANTINGS HEALING ROAD CUTS NATURE'S WAY. Retired SCS, USDA, Athens, Ga.

Eaman, T. K. COLORADO GRAZING ASSOCIATION HAS PROFITABLE LAND-USE AIM. SCS, USDA, Denver, Colo.

Archer, S. G. FERTILIZER AND REST BRING FESCUE BACK. SCS, USDA, Spartanburg, S.C.

Rogers, H. L. BETTER CATTLE NOT MORE CATTLE IS CONSERVATION RANCHER'S GOAL. Formerly SCS, USDA, Grangeville, Idaho.

Larson, P. F., Sampson, J., and Greenfield, S. F., Jr. BRUSH CONTROL BRINGS RANCHERS MORE GRASS FOR LIVESTOCK. SCS, USDA, Littlefield, Tex.

Gleue, F. C. "GRASS FARM" IS MODEL FOR BEST USE OF KANSAS LANDS. SCS, USDA, Belleville, Kans.

Anderson, E. CALIFORNIA FARMER FINDS GRASS CROPS BEAT WHEAT. SCS, USDA, Yreka, Calif.

Ellsbury, L. E. PONIES--GRASS SEED--AND CONSERVATION. SCS, USDA, Cody, Wyo.

Mills, R. H. COVER CROP SEEDING FROM THE AIR. SCS, USDA, Mansfield, Ohio.

Mason, L. USING HISTORICAL RECORDS TO DETERMINE CLIMAX VEGETATION. J. Soil and Water Conserv. 18: 190-194. 1963.

Historical records provide information of great value to the range conservationist. Such records can help him identify many of the plant species that were present in the climax native plant community on a range site. They supply a considerable amount of information about relative yields of range sites, and are invaluable aids in predicting potential site productivity. Records of the early-day historians indicate that certain plants are decreasers, others are increasers, and still others are invaders on given range sites. Enough details were given in some of the historical writings so that the range conservationist can determine the relative composition of the different species on many range sites.

SCS, USDA, Salt Lake City, Utah.

Shiflet, T. N. MAJOR ECOLOGICAL FACTORS CONTROLLING PLANT COMMUNITIES IN LOUISIANA MARSHES. J. Range Mangt. 16: 231-235. 1963.

Water depth and salinity exert major influences on plant composition of marshland ranges. Manipulation of these factors by use of pumps and levees can be used to change the plant composition to better fit the livestock enterprise. The giant-cutgrass community can be converted to longtom by lowering water level, preventing salt water intrusion, and mowing.

Seashore paspalum may become dominant when the longtom is killed by deep saline water such as that received from storm tides. Rapid removal of storm tide water is necessary if longtom stands are to be maintained. Seashore paspalum withstands more salt than longtom, tolerating up to 1.1 percent in the free soil water. The upper limit for longtom is 0.5 percent. Longtom requires a wet soil but will not tolerate more than 4 inches of water above the soil surface for extended periods of time. Seashore paspalum apparently requires some water above the surface to compete with other species and will stand a higher level of flooding than longtom.

SCS, USDA, Lake Charles, La.

Weaver, J. E. THE WONDERFUL PRAIRIE SOD. J. Range Mangt. 16: 165-171. 1963.

Big bluestem produces great numbers of branched rhizomes, 3 to 9 mm. in diameter, compacted into dense mats about 2 inches thick at depths between 1 and 3 inches. Their length per square foot of sod averaged 55 feet. Tensile strength was 55 to 64 pounds for individual rhizomes. Indian grass is similar to the big bluestem in total length of rhizomes and their position in the sod, but it is less efficient in spreading.

Switchgrass has rhizomes 3 to 7 mm. thick and 1 to 2 feet long. It differs from big bluestem by forming an open framework 2 to 5 inches, but sometimes 8 inches deep. A square foot of soil contains about 50 feet of much branched and interwoven rhizomes. A single rhizome exhibited a tensile strength of 80 to 132 pounds.

Beneath mature plants of prairie cordgrass, the soil to a depth of 6 to 10 inches contains a mat of coarse, woody, much branched rhizomes 4 to 8 mm. thick. Lateral branches originate at various depths from vertically placed rhizomes. Some exceed 2 feet in length and lateral spreading is rapid. Compared with big bluestem, the rhizomes are much coarser and the network much more open, but greater in the vertical dimension. Total length of rhizomes averaged 80 feet per square foot. On moist lowland, rhizomes are common on many grasses, sedges and rushes.

Of the rhizome networks of the four chief lowland grasses, that of big bluestem is the shallowest. That of Indian grass is very similar in the vertical dimension. Switchgrass forms an open network with a depth of 3 to 8 inches. Prairie cordgrass has a framework of variable thickness, ranging from 2 to 8 inches.

Rhizomes furnish abundant room for storage near the food factories above and they are close to the water and nutrient supplies around and beneath them. Fifty feet of rhizomes with an average diameter of 4 mm. have a volume of 11.7 cubic inches. Above these food-storage reservoirs the tall coarse grasses rapidly develop shoots, followed by an enormous expanse of leaves.

Dominants of uplands are mostly bunch grasses. The most abundant of these is little bluestem. Its compact bases are closely compressed in the surface 1.5 to 2 inches of soil. Roots arise from the bases of buried stems and spread outward in all directions, thus binding the stems together and firmly anchoring the bunch. Roots spread laterally in great numbers to at least 2 feet in the surface 4 inches of soil. Numerous other plants, especially other grasses, grow between the large bunches and also occupy a part of the upper soil. Their roots and rhizomes furnish a considerable part of the 2.6 to 3.15 tons of plant materials per acre in the upper four inches of soil--the bluestem sod. This is essentially true of bunches of prairie dropseed and needlegrass, which also maintain upland communities.

Prof. Emeritus, U. Nebr., Lincoln, Nebr.

Lodge, R. W. COMPLEMENTARY GRAZING SYSTEMS FOR SANDHILLS OF THE NORTHERN GREAT PLAINS. J. Range Mangt. 16: 240-244. 1963.

Three grazing systems which utilized crested wheatgrass and Sandhill prairie were compared with each other and with Sandhill prairie used alone. All three of these grazing systems had equal ratios of crested wheatgrass and Sandhill prairie but the length of season of use or accessibility of the crested wheatgrass was different. The three complementary grazing systems studied had advantages compared to Sandhill prairie alone. They gave increased liveweight gain on yearling steers, and as a result of increased carrying capacity, increased beef production per acre.

The system, spring use of crested wheatgrass and summer-fall use of both crested wheatgrass and Sandhill prairie, appeared to have merit over the other two systems. At the end of 7 years of grazing, the vegetation of the Sandhill prairie had a greater basal area of the valuable forage grasses.

Expt. Farm., Res. Br., Canada Dept. Agr., Swift Current, Saskatchewan, Canada.

Shoop, M. C., and McIlvain, E. H. THE MICRO-UNIT FORAGE INVENTORY METHOD. J. Range Mangt. 16: 172-179. 1963.

The micro-unit forage inventory method was developed as a simple, rapid, low cost technique to measure forage production and disappearance on rangeland at Woodward, Okla. Forage yields are measured by using the objective principle of counting estimated micro-units of each species within micro-plots. A micro-unit is an arbitrary small quantity of forage, usually ten grams, and a micro-plot is a small quadrat 1.917 sq. ft. in area.

The micro-unit is estimated by a visual appraisal combined with the sense of touch. Factors taken into account include: Size of leaf and stem, leaf-stem ratio; moisture content; previous-year's growth; utilization; and phenotypic variations. Range technicians can rapidly develop the necessary estimating ability. The estimated micro-unit can be checked quickly, usually within 30 seconds, by clipping and weighing. The scale used is about the size of a fountain pen.

The rectangular quadrat fram selected to delimit a micro-plot in the sand sage vegetation measured 11.5 by 24.0 inches. One end was left open to facilitate rapid and accurate placement. The dominant factor in selecting this small micro-plot was mental fatigue caused by estimating and counting micro-units in larger plots.

Forage production and disappearance can be obtained with the micro-unit method on a monthly, seasonal, or yearly basis. This is done by using a standard area-sampling technique and caged and uncaged plots. Cage numbers per pasture can be materially reduced by reading more than one micro-plot per cage.

The micro-unit method was compared with clipping in three trials. Forage weights estimated by the micro-unit method averaged 8 percent less than clipped weights, and varied from 13 percent less to 9 percent more. Estimated and clipped weights were highly correlated, 0.87. Differences between yield estimates of the same plot by individual examiners were slight, only about seven percent. First- and second-day estimates of micro-plots by the same examiners were highly correlated, 0.91.

Micro-plot yields were estimated in 34 seconds, whereas 4 minutes and 10 seconds was required to clip each micro-plot. In grazed pastures, about 2 minutes was required to estimate a micro-plot, move the cage, and travel to the next plot.

Number of micro-plots required for a valid estimate of yield varied directly with uniformity of vegetation and only indirectly with area.

Important advantages of the micro-unit method include: (1) Accurate estimation of yields; (2) use of estimates which can be quickly verified by clipping; and (3) use of small plots which can be delimited rapidly, studied intimately from one position, and caged economically. The main disadvantage to those not familiar with estimating will be the initial development of estimating skill.

CRD, ARS, USDA, U.S. Southern Great Plains Field Sta., Woodward, Okla.

Cook, C. W., and Lewis, C. E. COMPETITION BETWEEN BIG SAGEBRUSH AND SEEDED GRASSES ON FOOTHILL RANGES IN UTAH. J. Range Mangt. 16: 245-249. 1963.

From 1957-62, a study was conducted on foothill range in central Utah to determine the competitive effect of sagebrush on seeded grasses.

About 71 percent of the reinvading sagebrush present in the seeded areas was established 2 years after brush removal. The intensity of brush invasion ranged from 32.1 to 14.9 plants per 100 square-foot plot.

Death of brush from 2,4-D esters varied from 96.8 to 58.9 percent.

The zones of root concentration for sagebrush and the three seeded wheatgrasses were approximately the same. The average maximum depth of roots for the wheatgrasses was 51 to 58 inches while roots of the older sagebrush plants penetrated beyond 60 inches. Thus, direct competition for soil moisture was indicated between sagebrush and grass.

Soil moisture was significantly higher in sprayed than in unsprayed areas during the midsummer for 2 years following treatment. This difference increased with increased soil depth. No significant differences in soil moisture between sprayed and unsprayed plots were found during the third summer following treatment.

Yields increased after spraying by as much as 688 pounds per acre for crested wheatgrass, 322 pounds for intermediate wheatgrass, and 855 pounds for tall wheatgrass.

Grass plants on sprayed areas were taller and had longer leaves than plants on unsprayed areas during the first 2 years following treatment. Differences were only slight during the third year.

Utah State Agr. Expt. Sta., Utah State U., Logan, Utah.

Cook, C. W. HERBICIDE CONTROL OF SAGEBRUSH ON SEEDED FOOTHILL RANGES IN UTAH. J. Range Mangt. 16: 190-195. 1963.

During a 5-year period from 1958-62, a study was conducted in central Utah to determine the desirable rate and date of application of herbicide to control sagebrush invasion on seeded foothill range.

A selective herbicide composed of equal parts of isopropyl and butyl esters was applied in water at 5 gallons per acre at three rates (1.5, 2.0, and 3.0 pounds of acid equivalent per acre) on three dates (May 15, May 30, and June 15) for 5 years.

The early date (May 15) and the middle date (May 30) each gave best results 2 years out of the 5. During some years none of the treatment dates gave satisfactory results. However, May 15 and May 30 were considered more reliable dates than June 15. Increased rate of herbicide gave increased effectiveness in control of sagebrush. When growing conditions were favorable, all three rates gave satisfactory results; when growing conditions were unfavorable, none of the rates gave satisfactory control.

Soil moisture and atmospheric temperatures were limiting factors in the control of sagebrush on foothill ranges. When average percent soil moisture in the upper 2 feet was below 12 percent or when maximum and minimum atmospheric temperatures were below 70 and 40 degrees, respectively, on the day of treatment, satisfactory kills were not obtained.

Optimum soil moisture percentages for herbicide control of sagebrush on clay loam, silt loam, and sandy loam were about 12.5, 10.5, and 5.5, respectively.

Utah State U., Logan, Utah.

Kay, B. L., and McKell, C. M. PREEMERGENCE HERBICIDES AS AN AID IN SEEDING ANNUAL RANGELANDS. Weeds 11: 260-264. 1963.

Simazine, EPTC, and atrazine were shown to aid in the establishment of rose clover (Trifolium hirtum All.) and hardinggrass (Phalaris tuberosa L. var. stenoptera (Hack.) Hitch.) by reducing competition from resident annual plants, primarily medusahead (Elymus caput-medusae L.). The success of preemergence herbicides depends on fall precipitation in amounts great enough to permit seed germination and plant growth before winter temperatures become limiting.

U. Calif., Davis, Calif.

Lillie, D. T. CONTROL OF ARIZONA CHAPARRAL WITH 2,4,5-T AND SILVEX. J. Range Mangt. 16: 195-199. 1963.

Propylene glycol butyl ether (PGBE) esters of 2,4,5-T and silvex were applied to Arizona chaparral at 0, 1, 2, and 4 pounds per acre in the spring, spring-fall (of the same year), spring-spring, and spring-fall-spring, beginning in May 1959. In a second experiment 2,4,5-T and silvex were applied at 0, 2, and 4 pounds as the alkanolamine salt, as PGBE esters in Kuron and Esteron form, and as PGBE esters of 2,4,5-T and silvex in Forron formulation in the spring of 1959-60. All tests were made on replicated 25' x 50' plots.

The treatments resulted in varying degrees of topkilling of shrub live oak but most plants resprouted from the base or live branches. Treatment effects were recorded in terms of visual estimates of damage to tops of oak bushes as evidenced by dead leaves or lack of leaves. Silvex was generally slightly superior to 2,4,5-T.

The addition of 5 percent or more diesel oil emulsified in the water carrier increased effectiveness of 2,4,5-T in topkilling shrub live oak. When oil was included in the spray, there was no advantage in adding surfactant (above that in the formulated herbicide), but adding surfactant to sprays having no additional oil doubled the activity.

For any given schedule of retreatment, the higher application rates were more effective than the lower. However, the efficacy of the treatments was more related to frequency of retreatment than to total amount of herbicide applied. At any rate of herbicide, the effectiveness of the treatment increased with the number of applications made. When two treatments were applied, there was no difference between fall and spring retreatment.

There was no difference between PGBE esters of 2,4,5-T and silvex as Forron (in water) or standard (Kuron and Esteron in 1:7 oil/water emulsion) formulations; however, both were superior to alkanolamine salts of 2,4,5-T and silvex in aqueous solution.

CRD, ARS, USDA. Tempe, Ariz.

Kay, B. L. EFFECTS OF DALAPON ON A MEDUSAHEAD COMMUNITY. Weeds 11: 207-209. 1963.

Dalapon was applied to a predominantly medusahead (Elymus caput-medusae L.) community at rates of 1, 2, 3, 4, and 5 lb./A. and four stages of growth in California. Low rates of dalapon gave better control when applied at early growth stages than the same rates applied later. Reduction in total ground cover was less from December and February applications than from March applications.

Dalapon at 3 lb./A. applied 30 days after emergence gave 100 percent kill of medusahead. Two lb./A. gave 96 percent or better control when applied during the vegetative stage

(December, February, March). Both 2 and 3 lb./A. applied in December, and 2 lb./A. in February left a favorable balance of species among the remaining forage plants.

U. Calif., Davis, Calif.

Plant Materials

Henson, P. R. CROWNVETCH: A SOIL CONSERVING LEGUME AND A POTENTIAL PASTURE AND HAY PLANT. U.S. Dept. Agr., Agr. Res. Serv. ARS 34-53, 9 pp. 1963.

Crownvetch (Coronilla varia L.), a hardy, herbaceous, perennial legume, is not a true vetch although superficially it resembles the vetches. The genus Coronilla comprises between 20 and 30 species native to Europe, Asia Minor, and North Africa, but primarily countries bordering the Mediterranean Sea.

In the United States crownvetch was used chiefly as an ornamental plant for many years. The value of crownvetch for erosion control has long been recognized. Numerous publications attest to its value for this purpose on highway embankments, spoil banks in strip-mined areas, and other sites where erosion is a serious problem.

Crownvetch is a long-lived perennial legume, which spreads by creeping underground root stocks. The stems are leafy, hollow, and weak, ascend with support, and attain a height of 2 to 4 feet. The leaves are pinnate with 6 to 13 pairs of leaflets. The plant grows rapidly in the spring and matures a seed crop in midsummer. The flowers, borne in stalked umbels, are variegated in color, being white and shading to rose or violet.

Crownvetch has been observed in small plot trials in many areas of the United States. It appears to be well adapted north of the 35th parallel of latitude from Oklahoma eastward. In general, it grows best on well-drained soils. While excellent, persistent stands have been observed on moderately acid, rather infertile soils, most stands are not productive for hay or pasture without adequate fertilization and liming.

Inoculation: A specific strain of bacteria is required for proper inoculation. Specific directions for using crownvetch cultures, as found on the label of each container, should be followed in inoculating the seed.

Seeding: Crownvetch seed is hard and must be scarified before planting. Even with scarified seed, emergence and the seedling growth rate of the present varieties are very slow. Application of the fungicides thiram and captan to the seed before planting improved crownvetch seedling emergence in greenhouse studies. Once the seedlings are well established and in vigorous growth, relatively few plants per acre will result in good stands because of the spreading habit of growth due to the development of strong rhizomes.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md., 20781

Crops Research Division. RESULTS OF 1962 REGIONAL COTTON VARIETY TESTS BY COOPERATING AGRICULTURAL EXPERIMENT STATIONS: ALABAMA, ARIZONA, ARKANSAS, CALIFORNIA, GEORGIA, LOUISIANA, MISSISSIPPI, MISSOURI, NEVADA, NEW MEXICO, NORTH CAROLINA, OKLAHOMA, SOUTH CAROLINA, TENNESSEE, TEXAS. U.S. Dept. Agr., Agr. Res. Serv. ARS 34-60, 58 pp. 1963.

The test results were presented in a series of tables designed to furnish reliable information on the performance of cotton varieties in experimental tests across the United States in 1962. No interpretation of these data, other than the indication of significant difference among means based on the analysis of variance, was presented.

In the summary of data for individual stations, the varieties were arranged in descending order of yield of lint per acre. Analysis of variance of yield was calculated for each individual station.

In the regional summaries, each character was ranked separately in descending order and the significant difference among means were indicated. For easy examination, the mean performance of a variety for all measurements were retabulated into a single table for each region.

The mean performance of the stations, within each region, were also presented.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md., 20781

Woodlands

Smith, W. H., Nelson, L. E., and Switzer, G. L. THE CHARACTERIZATION OF DRY MATTER AND NITROGEN ACCUMULATION BY LOBLOLLY PINE (Pinus taeda L.) ON POOR SITES. Soil Sci. Soc. Amer. Proc. 27: 465-468. 1963.

Twenty-five trees, equally distributed to represent five tree developmental stages, were sampled on uplands with a site index of 65 feet in central Mississippi. The aerial portion of the trees was divided into seven components and dry matter and total nitrogen contents of each determined. The pattern of dry matter accumulation by the individual trees and stands through the series of developmental stages differed. The individual tree and all its parts make accretions throughout development, while some portions of the stands reach a fairly constant level at 23 years. At 60 years, the stand contained 126,000 pounds of dry matter per acre of which 56 percent was accumulated during the first 23 years.

The pattern of nitrogen accumulation within the individual tree and its parts was similar to that of dry matter while for the stand the similarity was not so striking. This variation was chiefly brought about by the variations in crown and canopy development. At 60 years, a standing crop contained approximately 170 pounds of N per acre of which 77 percent was accumulated during the first 23 years.

Miss. Agr. Expt. Sta., State College, Miss.

Boggess, W. R., and Gilmore, A. R. EARLY GROWTH OF LOBLOLLY AND SHORTLEAF PINE AT VARIOUS SPACINGS IN SOUTHERN ILLINOIS. Trans. Ill. State Acad. Sci. 56: 19-26. 1963.

Past practices on land cleared for agriculture in southern Illinois have reduced the quality of many sites to the point where the valuable native hardwood species cannot be successfully grown. It has been necessary to find less demanding species to reforest these degraded sites. Shortleaf pine (Pinus echinata Mill.) and loblolly pine (Pinus taeda L.) have been widely planted in this area, which is at the limit or north of their present natural ranges. Loblolly pine and shortleaf pine were planted at spacings of 4 x 4-, 6 x 6-, 8 x 8-, and 10 x 10-feet on a site of medium quality in southern Illinois. Growth and yield data were collected at the end of the eleventh and thirteenth growing seasons. The authors concluded that:

1. Spacing had little effect on tree heights, but diameters were larger at the wider spacings.

2. Loblolly was taller, larger in diameter, and produced significantly more wood than shortleaf pine at each spacing. Spacings between 6 x 6 feet and 8 x 8 feet were suggested for planting loblolly pine, but the results did not yet warrant similar recommendations for shortleaf pine.
3. Growth and yield of both species compared favorably with that reported for similar studies in the Piedmont Region of Alabama and Georgia.

U. Ill., Urbana, Ill.

Switzer, G. L., and Nelson, L. E. EFFECTS OF NURSERY FERTILITY AND DENSITY ON SEEDLING CHARACTERISTICS, YIELD, AND FIELD PERFORMANCE OF LOBLOLLY PINE (PINUS TAEDA L.). Soil Sci. Soc. Amer. Proc. 27: 461-464. 1963.

The effects of nursery fertility and density were studied over a 3-year period using a 3 X 4 factorial arrangement of fertility and density. The fertility levels employed were 75 - 22 - 62, 150 - 44 - 124, and 300 - 88 - 249 pounds of N - P - K, respectively. The densities were 15, 30, 45, and 60 seedlings per square foot.

Generally, increasing fertility increased the concentrations of N, P, and K and had no effect on Ca and Mg in the foliage. No such effects of density were noted. The total nutrient content of the foliage and the plant size increased with increasing fertility and decreasing density. Fertility and density interacted to control yield of plantable seedlings. At a density of 15 seedlings per square foot, the yield over the range of fertilities used varied from 94 to 92 percent, while at a density to 60 seedlings per square foot the yield was increased from 34 to 81 percent.

The effects of nursery treatment on field performance on two site extremes were strongly related to field height growth, but not to survival. Total height at the completion of three field growing seasons increased with increasing fertility and decreasing density. Field height growth was related to such seedling characteristics as size and nitrogen content at lifting.

Miss. Agr. Expt. Sta., State College, Miss.

MacLean. C. D. IMPROVING FOREST INVENTORY AREA STATISTICS THROUGH SUPPLEMENTARY PHOTO INTERPRETATION. J. Forestry 61: 512-516. 1963.

Supplementary photo interpretation of major land-use class proved an excellent means of improving forest inventory estimates of commercial forest land area. Even though tremendous gains in accuracy were realized, this type of interpretation proved relatively inexpensive. The full cost can be absorbed by a slight reduction in field plots. A combined field and photo survey can be expected to provide an estimate of commercial forest land area at a substantially lower cost than a field plot survey of equivalent accuracy. Stratified double-sample surveys were from 6 to 15 times more efficient in estimating commercial forest area than surveys based solely on field plots.

When photo interpretation was limited to major land-use classes, commercial forest land area still needed to be broken down into its component classes from field plot data. When the cost of photo interpretation was absorbed by reducing the number of field plots, this breakdown was based on a lesser number of field plots than would be taken in a straight field survey. However, an improved estimate in commercial forest area compensated for this loss. The combined field and photo survey usually estimated these area classes with an accuracy that was equal to or greater than that obtained from a field plot survey.

Supplemental photo classification of stand-size and stocking classes seemed to be of limited usefulness. It may pay in areas where stands are uniform and even-aged. Photo plots proved more efficient when evenly distributed than when clustered at regular intervals. The low sampling error gained by even distribution more than compensated for the loss in field plots brought about by higher interpretation costs.

The stratified double sample with evenly distributed photo plots produced estimates of commercial forest land much more efficiently than a survey based on field plots alone, even when the photo-to-field plot ratio was as low as 10 to 1. The most efficient ratios were 50 to 1 or greater.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Oreg.

Sowder, A. M. CHRISTMAS TREE DATA FOR 1962. J. Forestry 61: 869-871. 1963.

For 1962, the U.S. production of Christmas trees was 33-1/3 million, of which Scotch pine made up 21 percent; Douglas-fir, 20 percent; Balsam fir, 15 percent; Norway or red pine, 10 percent; and Eastern red cedar 7 percent.

These same five species last Christmas made up nearly three-fourths (73 percent) of our U.S. production. Over 25 species of evergreens made up the remaining 27 percent with five percent each of white spruce and black spruce, respectively.

Over 62 percent of our Christmas trees in 1962 came from wild or natural stands. A very small percent of these were sheared. On the other hand, most of the 38 percent harvested from planted areas were sheared.

In 1962, stumpage value of the Christmas trees harvested amounted to $22-1/2 million. This amounted to $41-1/3 million wholesale value and over $96 million retail value.

FES, USDA, Washington, D.C., 20250

Bethune, J. E., and Hepting, G. H. PITCH CANKER DAMAGE TO SOUTH FLORIDA SLASH PINE. J. Forestry 61: 517-519, 522. 1963.

Observations of incidence, rate of spread, and effect on tree growth and mortality of pitch canker disease caused by Fusarium lateritium f. pini were made in pulpwood-size stands of South Florida slash pine (Pinus elliottii var. densa). Incidence increased rapidly over a 5-year period, but was not correlated with either tree crown class or diameter. Removal of all diseased trees from some plots had no effect on rate of infection of remaining trees. The disease originated more often in the leaders of young trees than in the branches. Reduced diameter growth and increased rate of mortality were observed in pitch cankered trees. When diseased trees were not killed by the canker, they were commonly malformed. Pitch cankered trees should be discriminated against during thinning but only the more seriously diseased trees should be removed, if heavier thinning would result in a drastically understocked stand.

Southeastern Forest Expt. Sta., FS, USDA, Asheville, N.C.

Miller, W. F. BETTER HARDWOOD KILL OBTAINED IF MOISTURE IS HIGH. Miss. Farm Res. 26(5): 3. 1963.

Recognizing the need to increase the efficiency of herbicides used in forestry practices, the Mississippi Experiment Station has been engaged since 1959 in studies to determine the best chemical rate and method of application, formulation and carrier for hardwood control. Only 2,4,5-T was found to be adequate for woody plant control and even this chemical gave variable results. In an attempt to explain this variability, a study of the influence of season and site conditions at the time of spraying was initiated in 1960. Beginning on May 30 and continuing through September 12, one plot per week was treated with a portable mistblower using a non-emulsifiable ester formulation of 2,4,5-T in a diesel oil carrier at the rate of 2 pounds acid equivalent in three gallons total solution. Southern red oak, post oak, hickory, sweetgum, and loblolly pine trees were sprayed.

The hardwoods were more easily killed with an increasing moisture supply and although the trend of pine kill and number of days was not strongly defined, there was an increasing pine kill as the moisture supply was depleted. Other measures of weather such as maximum air temperature and wind velocity on the spray date were also found to be important in explaining variation in kill.

Table. Relationship between percent total kill and number of days since a rainfall greater than or equal to one-half inch.

Number of Days	Percent Total Kill		
	Pine	All Hardwoods	Sweetgum
0	26	42	92
15	27	35	72
30	28	28	52
45	29	21	32

No address given.

Windbreaks

Stoeckeler, J. H. SHELTERBELTS AND THEIR EFFECTS ON CROP YIELDS IN THE GREAT PLAINS. J. Soil and Water Conserv. 18: 139-144. 1963.

Under Great Plains conditions between the 98th and 100th meridians, the net increase in yields of small grains due to the beneficial effects of 16.5-foot-wide shelterbelts about 40 feet high was estimated to be 0.67 to 1.34 bushels per acre. For ear corn, the net increase in yields was 0.87 to 1.74 bushels per acre. The lower figure given for each crop was for 4 lineal miles of parallel east-west belt per square mile, while the higher figure was for 8 lineal miles of parallel east-west belt per square mile.

Crop benefits near shelterbelts in the Dakotas were higher than those in Nebraska or Kansas; this was due partly to larger accumulations of snow and subsequent increases in soil moisture recharge near belts in the Dakotas.

Field shelterbelts should be regarded as a long-range investment in wind erosion control. They also have some merit as a means of controlling snowdrifting near roads, beautifying the landscape, and providing shelter and food for wildlife.

More research is needed on crop benefits near narrow shelterbelts for this area. Management of shelterbelts to provide continuous soil protection and to improve crop yields also deserves greater attention.

Lake States Forest Expt. Sta., FS, USDA, St. Paul, Minn.

Swenson, W. S. PONDEROSA PINE AND ROCKY MOUNTAIN JUNIPER GROWTH IN THE GREAT PLAINS AREA OF EASTERN COLORADO. J. Forestry 61: 867-868. 1963.

In eastern Colorado where the annual precipitation averages 14 inches per year, snow moisture trapped in shelterbelts and windbreaks had a significant effect on tree growth. Both diameter and height were affected. Measurements of ponderosa pine 35 years of age showed a variation from a site index of 70 (based on 100-year height) to site index 50, depending upon the distance from the windward side of a multi-row windbreak. Tree vigor was noticeably better where drifted snow was caught. The effect of drifted snow showed for about 120 feet from the windward edge of the belt. In this study, the soil was uniform throughout the belt.

SCS, USDA, Denver, Colo.

Fruit and Nut Crops

Soil Conserv. 29(2): 27-48. Sept. 1963.

This special issue of Soil Conservation was devoted to the results of conservation practices for fruit and nut crops. The following articles were given:

Ice, P. W. CONSERVATION IS HELPING FAMILY TO $500,000 ORCHARD INCOME GOAL. SCS, USDA, Murphysboro, Ill.
Dean, J. O. WIND EROSION CONTROL IN VINEYARDS HELPS CALIFORNIA'S CUCAMONGA AREA. SCS, USDA, Riverside, Calif.
Miller, W. D. SOD--COVER CROPS--CONTOURING SOLVE MICHIGAN ORCHARD PROBLEMS. SCS, USDA, Grand Rapids, Mich.
Van Arsdall, H. E. CONTOUR PLANTING--WATER USE SERVE FLORIDA CITRUS GROWERS. SCS, USDA, Gainesville, Fla.
Abbott, F. D., and Gaskell, L. J. NATIVE PECANS NOW PAYING CROP FOR KANSAS CONSERVATION FARMERS. SCS, USDA, Salina, Kans.
Kiehle, J. D., and Mason, W. A., Jr. GRAPE GROWERS--AREAS GAIN FROM CONSERVATION. SCS, USDA, Penn Yan, N.Y.
Lowe, C. T. FRUITS OF CONSERVATION. SCS, USDA, Payson, Utah.
Alcorn, F. B. CONSERVATION BERRY FARMING-FORMULA FOR FAMILY'S SUCCESS. SCS, USDA, Anna, Ill.
Britt, C. S., and Robinson, R. R. TIMING PEACH ORCHARD COVER CROPS TO CUT DOWN MOISTURE COMPETITION. SWCRD, ARS, USDA, Beltsville, Md., 20705.
Marrero, J. F. CONSERVATION HELPS BRING BACK PUERTO RICO'S COFFEE PRODUCTION. SCS, USDA, Santurce, Puerto Rico.
Conklyn, J. H. GOOD SOIL MANAGEMENT HELPS WEST VIRGINIA APPLE GROWER. SCS, USDA, Martinsburg, Va.
Dixon, J. COVER CROPS PREVENT EROSION--PRODUCE TASTIER FRUIT. SCS, USDA, Grand Junction, Colo.
Carlton, E. P. TERRACES STOP "WET FEET" IN OHIOAN'S PEACH ORCHARD. SCS, USDA, Cuyahoga Falls, Ohio.
Lonzway, R. R. NEW ORCHARD FOR OLD PAYS OFF FOR OREGONIAN. SCS, USDA, Milton-Freewater, Oreg.
Roach, D. E. WENATCHEE ORCHARDS TAKE TO COVER. Formerly SCS, USDA, Wenatchee, Wash.

Kinnison, A. F. ORCHARD AND VINEYARD LAND USE IN THE WEST. J. Soil and Water Conserv. 18: 153-156. 1963.

The long growing season, the large number of days of sunshine, the relatively rainless summers, and the availability of water for irrigation in most western fruit growing areas are conditions that favor the production of fruit of good color and excellent quality in California and Arizona. Soil and water conservation practices that must be wisely applied to the significant amount of land in the western states that is used for commercial production of fruit if orchards and vineyards are to produce maximum yields on a sustained basis were given.

Retired from Farm and Ranch Planning Div., SCS, USDA, Berkeley, Calif.

Ries, S. K., Larsen, R. P., and Kenworthy, A. L. THE APPARENT INFLUENCE OF SIMAZINE ON NITROGEN NUTRITION OF PEACH AND APPLE TREES. Weeds 11: 270-273. 1963.

Peach trees treated with the herbicide mixture of simazine and amitrole-T had higher leaf nitrogen and more growth than trees where the weeds were controlled by hand hoeing or a black plastic mulch. Apple trees had higher leaf nitrogen and more growth when treated with simazine and amitrole-T than with no weed control. In both peaches and apples, more growth and higher leaf nitrogen resulted from the herbicide treatments than from supplemental nitrogen treatments, indicating that the herbicide influenced the nitrogen metabolism of these trees.

Mich. State U., East Lansing, Mich.

Ross, R. G., and Longley, R. P. EFFECT OF FUNGICIDES ON MCINTOSH APPLE TREES. Canad. J. Plant Sci. 43: 497-502. 1963.

A 4-year test was carried out on the effect of sprays of captan, dodine, dichlone, and phenyl mercury acetate-captan on the performance of mature McIntosh apple trees. Increases in yield of the same trees over the average yield of the previous 5 years were 40, 31, 18, and 7 percent, respectively, for captan, dodine, mercury-captan, and dichlone. The fungicides had little effect on bloom, tree growth as measured by increase in trunk cross-section, and percent fruit color. Mercury-captan produced larger apples indicating a thinning effect. The captan sprays produced the most attractive apples. With dichlone, fruit finish was rough. Dodine injured about 3 percent of the apples in 2 years of the test.

Dodine gave the best control of apple scab (Venturia inaequalis). Dichlone was very effective for early fruit scab but did not give good control of late or pin-point scab. Mercury gave excellent control of early scab. Captan allowed some late scab to develop.

Canada Dept. Agr., Kentville, Nova Scotia, Canada.

Rollins, H. A., Jr., Bobb, M. L., Drake, C. R., Groves, A. B., and Hill, C. H. 1963 SPRAY BULLETIN FOR TREE FRUITS. W. Va. Coop. Ext. Serv. C. 393, 36 pp. Rev. 1962., and Va. Polytech. Inst. Ext. B. 131, 36 pp. Rev. 1962.

The production and marketing of fruit are important agricultural industries of West Virginia and Virginia. Fruit growing is a highly specialized industry with many problems in which pest control is one of the most troublesome.

The same publication is published by the Extension Services of West Virginia and Virginia and provides the latest information on pest control. The information and recommendations given were based on experimental results as well as grower experience.

W. Va. Coop. Ext. Serv., West Va. U., Morgantown, W. Va. or Va. Agr. Ext. Serv., Va. Polytech. Inst., Blacksburg, Va.

Field Crops

Pittman, U. J. MAGNETISM AND PLANT GROWTH: I. EFFECT ON GERMINATION AND EARLY GROWTH OF CEREAL SEEDS. Canad. J. Plant Sci. 43: 513-518. 1963.

Chinook wheat, Victory oats, Compana barley, Redwood flax, and common fall rye were used as test crops. Growth was greater in a 48-hour germination period when the seeds of these crops were oriented longitudinally parallel to the lines of force in a known magnetic field than when the seeds were orientated horizontally at right-angles to those magnetic lines. The primary root, the primary-lateral roots, and the coleoptile usually all responded similarly to the orientation treatment relative to the direction of the lines of force. However, this response was slightly less evident in the primary-lateral roots of Victory oats than in other plant parts or species.

Growth responses of approximately the same nature and magnitude were obtained when the orientation treatment during germination was relative to the geomagnetic lines of force or to those of an introduced magnetic field. It appears, therefore, that a magnetic field of relatively low intensity may be as effective in stimulating or initiating a growth response as one of higher intensity.

Canada Agr. Res. Sta., Lethbridge, Alberta. Canada.

Quinby, J. R., Stewart, R. B., and Watkins, G. M. SEED TREATMENT STUDIES ON SORGHUM IN TEXAS. Agron. J. 55: 550-551. 1963.

Seed of 6 varieties of sorghum and 1 hybrid were treated with 23 different seed protectants. The treated seeds along with untreated checks of each variety were planted for 3 consecutive years at College Station, Tex., and for 4 years at Chillicothe, Tex.

The most effective seed treatments increased emergence about 10 percent but the least effective treatments did not increase emergence.

The organic protectants were more effective than the mercurial protectants. One of the organic-insecticide protectants was as effective as any organic protectant alone.

The protection given by the most effective chemicals increased as the seed aged. Seed more than 2 years old did not emerge well enough for such seed to be used safely for planting.

Pioneer Sorghum Co., Plainview, Tex.

Holstun, J. T., Jr. CULTIVATION TECHNIQUES IN COMBINATION WITH CHEMICAL WEED CONTROL IN COTTON. Weeds 11: 190-194. 1963.

Unshielded cultivation (during which soil is purposely moved into the drill row) and shielded cultivation (soil movement into drill row minimized) were compared in field plots of cotton (Gossypium hirsutum L. (var. DBES 8274)) which received no herbicide, a banded preemergence herbicide, one to three banded postemergence herbicide applications, or a combination of the banded pre- and postemergence herbicides. All plots were hoed and cultivated as needed to maintain reasonably good control of weeds. The study was a 3-year experiment replicated six times.

Unshielded cultivation was superior or equal to shielded cultivation as a weed control measure supplementary to hoeing or hoeing and herbicides as evaluated by effects on hoe-labor requirements, cotton yields, and weed infestations at harvest time. Replacing one or more postemergence herbicide applications with unshielded cultivation resulted in reduced control of weeds. Late season initiation of unshielded cultivation in plots previously shield cultivated had no detrimental effect on yield.

Significant increases in yield of cotton were obtained in plots treated with a preemergence herbicide as compared with plots receiving only hoeing and cultivation for weed control. Postemergence herbicide treatments (applied as a directed spray) did not result in significantly higher yields as compared with plots receiving hoeing and cultivation only. As measured by 3-year averages, preemergence or postemergence treatments provided about 50 percent control of weeds; combined they provided about 75 percent control.

CRD, ARS, USDA, Stoneville, Miss.

Buchholtz, K. P. USE OF ATRAZINE AND OTHER TRIAZINE HERBICIDES IN CONTROL OF QUACKGRASS IN CORN FIELDS. Weeds 11: 202-205. 1963.

Application of atrazine was effective in controlling quackgrass (Agropyron repens) in fields planted to corn. Corn yields were greatly improved by the treatment. Most favorable dates of application were in the fall or in the early spring before planting. Applications after corn planting were much less effective. Favorable rates of application were 2 to 4 lb./A. Atrazine and simazine were generally superior to other triazine analogues used. Greater solubility and greater activity as a foliar spray favored use of atrazine for control of quackgrass.

U. Wis., Madison, Wis.

Sullivan, E. F., Abrams, R. L., and Wood, R. R. WEED CONTROL IN SUGAR BEETS BY COMBINATIONS OF THIOLCARBAMATE HERBICIDES. Weeds 11: 258-260. 1963.

The herbicides n-propyl ethyl-n-butylthiolcarbamate (PEBC), PEBC + 2,3-dichloroallyl diisopropylthiolcarbamate (DATC), PEBC + ethyl N,N-di-n-propylthiolcarbamate (EPTC), and PEBC + 2,3,3-trichloroallyl diisopropyldithiolcarbamate (CP-22819) among others produced effective control of lambsquarters (Chenopodium album), pigweed (Amaranthus retroflexus), Setaria spp., and other weed species without undue injury to sugar beet seedlings. PEBC + DATC also gave control of wild oat (Avena fatua), and increased the control of lambsquarters; however, this latter effect was inversely related to the control of other broadleaved weeds. Control equal to PEBC was produced by PEBC + EPTC with 2.5 lb. less total active ingredient per acre. The herbicide endothal gave inferior control of weeds. None of the herbicides tested effectively controlled kochia (Kochia scoparia).

Agr. Expt. Sta., Great Western Sugar Co., Longmont, Colo.

Davis, V. W. ECONOMIC CONSIDERATIONS IN CHOOSING A CORN HARVESTING METHOD. Ill. Agr. Expt. Sta. AERR-63, 31 pp. 1963.

Each farm is a case problem with respect to the number and size of enterprises, type and arrangement of buildings, kinds and methods of handling feeds, amounts of the demands for available labor and capital, and plans for the future. Tables of standards combined with a cost budget form can serve as a useful tool to assist in making the correct choice of a harvesting method to fit particular needs and circumstances. Some general comparisons and recommendations to guide the decision were:

1. Harvesting ear corn was the most important method used in the Corn Belt, 79 percent of all corn was harvested in this way in 1962.
2. Field shelling is increasing each year at a moderate rate of two to three percentage points. Field-shelled corn accounted for an estimated 16 percent of all corn harvested in the Corn Belt in 1962. Field-shelled corn was: (1) Dried and marketed without farm storage or dried and stored on the farm for feed or future marketing, 50 percent; (2) marketed direct without farm storage, 34 percent; and (3) stored as high-moisture-shelled corn for feed, 16 percent.
3. Whether corn was marketed direct from the field or through livestock products, the harvesting system should be planned from harvest through final disposition.
4. Most of the factors affecting the choice of a harvesting method relate directly or indirectly to costs. Some of the important factors included: (1) Volume to be harvested; (2) existing machinery and structures; (3) field losses; available labor and capital; (4) land use; and (5) ultimate use of the grain.
5. Early harvesting reduced harvesting costs because field losses were smaller and working conditions were better. Field losses were least for field shelling with a combine and storing as high-moisture corn and greatest for conventional ear-corn harvesting and crib-storage.
6. Field shelling was more economical in both labor and machinery than picking and then shelling with a stationary sheller either in the field or at the crib.
7. Mechanical drying was used as a replacement for drying by natural means. The more rapidly corn was dried, the more it cost in initial investment and operating costs for drying and sometimes in quality of corn.
8. Storage for dry shelled corn cost less than half as much for ear-corn storage. On a dry matter basis, cost per bushel of capacity was about 1 1/2 times as much for high-moisture ground ear corn as for high-moisture shelled corn.
9. The choice of field-shelling equipment was determined for volumes of 8,000 to 11,000 bushels. The picker-and sheller was most economical to use for smaller volumes, and the combine with corn-head attachment for larger volumes.
10. Harvesting and storing high-moisture shelled or ground ear-corn was the least costly method for cattle feeders.
11. Supplemental heat was the most economical drying system for volumes below 22,000 bushels when all new harvesting equipment and storage structures were assumed. A portable-batch drying method was most suitable for the farmer who has a large volume to dry, needs to dry fast, and requires the advantage of mobile, flexible equipment. Costs were less than ear-corn harvesting and crib storage at volumes larger than 10,000 bushels.
12. Additional methods of handling corn, such as batch-bin drying and portable-batch drying with ear-corn cribs converted to shelled corn storage, can be considered if there is a crib on the farm that is sound and adequate for ear-corn storage or conversion to shelled corn storage. Portable-batch drying costs were less than storing ear corn in a crib at volumes greater than 13,000 bushels.

Agr. Expt. Sta., U. Ill., Col. Agr., Urbana, Ill.

Vegetable Crops

Poole, W. D., Hernandez, T., Hernandez, T., Barry, J. R., Jr., and Wascom, B. W. CHEMICAL WEED CONTROL IN SWEET POTATOES. La. Agr. Expt. Sta. B. 563, 23 pp. 1963.

The results of tests for chemical weed control in sweet potatoes were given. It was concluded that:

1. Herbicides can be effectively used to control grass and weeds in sweet potatoes.
2. When mechanical transplanters were used for setting plants prior to herbicide treatment, these plants gave a higher yield than did the plants that were set by the hand-stick method.
3. Post-planting treatments with herbicides were better suited to field practices than a pre-planting treatment.
4. When plants were set by the hand-stick method, the holes left by the stick had to be carefully closed before applying the herbicide.
5. Granular herbicide proved to be just as effective as a liquid spray of the same herbicide.
6. The ridge left by the transplanter press wheel when setting the plants did not hinder the effectiveness of the herbicide which was applied later.
7. Rows made up and left standing must be dragged clean of any germinated weed and grass seed before setting the plants and applying the herbicide.
8. The herbicide should be applied as soon as possible after setting the plants; this time interval should never exceed two days.
9. The effectiveness of the herbicide varied somewhat depending on weather conditions.

The herbicides recommended (Randox and Eptam for liquid spraying and Randox, Alanap 10 G, and Eptam for granular applications) were field tested on sweet potato plants and proved to be relatively safe to use on plants under normal field conditions and at the same time gave satisfactory weed and grass control.

La. State U. and Agr. and Mech. Col., Agr. Expt. Sta., University Station, La.

Duncan, H. E., and Gallegly, M. E. FIELD TRIALS FOR CHEMICAL CONTROL OF SEEDPIECE DECAY AND BLACKLEG OF POTATO. Amer. Potato J. 40: 279-284. 1963.

Field trials for chemical control of potato seedpiece decay and blackleg, carried out in 1959-61 revealed little if any benefit from seedpiece treatment when the cutting, treating, and planting operations were done the same day. However, if seed were cut and treated a month before planting, some detrimental and some beneficial results were obtained. Streptomycin (Agrimycin 100 or Phytomycin) used at 100 p.p.m. caused a reduction in stand and yield when used 30 days before planting. The percentage stand and the yield from pre-cut seed receiving no treatment were lower than those from non-treated seed cut at time of planting. Treatment of pre-cut seed with captan resulted in stands and yields equal to those obtained from any of the treatments of seed cut at time of planting. Treatment with streptomycin in combination with captan or dieldrin, or both, failed to offset the harmful effects of streptomycin on pre-cut seed. Treatment with dieldrin was neither beneficial nor harmful.

The seed-corn maggot was not a major factor in blackleg development in these trials. The amount of blackleg which developed was small and little if any control was obtained by chemical seed treatment. Reductions in stand also occurred from pre-cut seed treated with the antibiotics albamycin, viridogrisein, griseoviridin, Chloromycetin, and ABT 26,778. Zineb and maneb appeared to be equal to captan as a treatment of pre-cut seed.

W. Va. Agr. Expt. Sta., Morgantown, West Va.

ECONOMIC AND SOCIAL ASPECTS OF SOIL AND WATER CONSERVATION

Costs and Returns

Rogers, R. H., Henderson, R. C., and Smith, R. M. ECONOMIC ANALYSIS OF FARMING OPERATIONS ON THE BLACKLAND EXPERIMENT STATION, TEMPLE, TEXAS, 1955-61. Tex. Agr. Expt. Sta. MP-641, 7 pp. 1963.

In this analysis of 7 years operations, it was concluded that on a sloping Blackland farm of 350 acres, with 275 acres of cropland in an area where cotton root rot is severe, it is possible to obtain a "going" return to capital and labor, plus a limited return to management. At the same time, soil and water resources can be conserved.

Only 15 percent of the cropland on this farm was devoted to cotton production. The range was from 9 to 18 percent among years. In former years, many farmers in the area grew cotton on a much higher percentage of cropland.

Cotton production averaged 213 pounds of lint per acre, ranging from 55 pounds in 1960 to 356 pounds in 1955. In 1961, the average was 180 pounds per acre. This is a little above the long-time average for the area. The average per acre return to management was $16.52, with a range from $64.05 to minus $23.61. The price received per pound of lint averaged 27 cents, and cottonseed averaged $44 a ton. At these prices, and with yields affected so much by recurring root rot damage, it would seem practical to keep cotton acreage around 15 to 20 percent of the cropland to permit production of feed and forage for livestock enterprise on the remaining acreage and to follow approved soil conservation practices.

On land subject to erosion, either close-growing planted crops or permanent grasses made reasonable returns when used in connection with a sound livestock program. This was also true for bottom land with subsurface moisture or where overflow occurred too often for satisfactory cultivation. The period of study was not long enough to provide definite conclusions on the economic advantages of the rotations used.

The possibility of using stocker and feeder cattle in utilizing pasture, forage, and homegrown feed on Blackland farms where soil conserving practices are followed was indicated. In adjusting to a farm program that includes livestock, some Blackland farmers favor a cow-calf enterprise. Others have found advantages in combining cow-calf and stocker or feeder operations, or all three.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Strickland, P. L., Jr., Plaxico, J. S., and Lagrone, W. F. MINIMUM LAND REQUIREMENTS AND ADJUSTMENTS FOR SPECIFIED INCOME LEVELS, SOUTHWESTERN OKLAHOMA. Okla. Agr. Expt. Sta. B. B-608, May 1963.

The changes required to achieve specified returns in farm income of an 11-county area in southwestern Oklahoma were studied.

Over 80 percent of the farms within the area were too small, even with efficient operation, to give a minimum return to operator labor and management of $3,000. If the land area were adjusted into farms of the minimum size to obtain a $3,000 return, the number of farms could be reduced by approximately 50 percent. If the land area were adjusted into farms of the minimum size to obtain a $5,000 return to operator labor and management, which is the average income in nonfarm employment, only about 30 percent of the present number of farms would be possible.

Although some of the displaced farm operators could be employed as hired laborers on the reorganized farms, most of them would require employment in nonfarm work. In most instances, they would require training in nonfarm skills. Also, obtaining nonfarm employment probably would require moving to another area to perform the work.

The findings indicate that farm output may not decrease with a substantial outward adjustment of farm labor if the remaining farms reorganize into larger units.

Based on the interest rates used, it appears that assumed land prices are probably higher than present farm income justifies.

The results reflect the minimum requirements and resource adjustments needed to obtain the specified incomes if the farms were operated in the efficient manner assumed, and if farmers have perfect knowledge. The study was not intended to predict the actual reaction of farmers, nor the actual adjustment pattern farmers will take.

Okla. State U. Expt. Sta., Stillwater, Okla.

Beaty, E. R., Hayes, D. D., and Worley, E. E. VALUE OF PELLETED FESCUE, BROWNTOP MILLET, AND WHOLE STALK CORN AS STEER FEED. Agron. J. 55: 531-532. 1963.

When pelleted whole-stalk corn and fescue were fed to growing steers, feed intake and gains were not different from those of steers fed ground snapped corn. Pelleted browntop millet was consumed at the same rate but gains were reduced.

U. Ga., Col. Agr. Expt. Sta., Athens, Ga.

Hoglund, C. R. CAN ALFALFA COMPETE WITH CORN ON PRODUCTIVE DAIRY FARMS? J. Soil and Water Conserv. 18: 200-204. 1963.

Technological advances in agriculture and constantly changing economic relationships should and do result in alterations in cropping systems designed for maximum profitable production on a sustained basis. The competitive position of alfalfa in the cropping system was studied.

The author concluded that it will probably be increasingly more difficult for alfalfa to compete with the corn crop on the most productive cropland. Increases in size of dairy herds, accompanied by greater mechanization, will result in increased use of silages, particularly of corn, and less direct grazing. Only with the use of ideal crop and dairy production practices will alfalfa be able to compete favorably with corn for a portion of the cropland acreage on level, highly productive land. Alfalfa will continue to be an important and profitable feed crop on farms not well suited to the production of corn.

Mich. State U., East Lansing, Mich.

Institutional, Educational, and Social Factors Affecting Conservation Application

Soil Conserv. 29(4): 75-96. Nov. 1963.

This special issue of Soil Conservation was devoted to conservation problems of the Rural-Urban fringe areas in recognition of Farm-City Week observances from November 22-28. The following articles were given:

Marshall, R. M. SOIL SURVEYS ARE GUIDES FOR MANY URBAN-AREA DEVELOPMENTS. SCS, USDA, Washington, D.C., 20250
Molinaroli, R. CITY AND COUNTY PLAN AHEAD TO MEET URBANIZATION PROBLEMS. Former Engineer, SCS, USDA, Charleston, S.C.
Franklin, A., and Richardson, B. CALIFORNIA URBANIZATION SPURS CITRUS LAND SHIFTS--CONSERVATION. SCS, USDA, Stockton, Calif.
Dove, W. H. OHIO FARMLAND IS CONVERTED TO CITY PEOPLE'S PLAYGROUND. SCS, USDA, Bellefontaine, Ohio.
Williams, D. A. LAND--WATER--PEOPLE. SCS, USDA, Washington, D.C., 20250
Freeman, O. L. "LET US VOTE FOR GRASS AND WATER". Sec. Agr., Washington, D.C., 20250
Schott, J. D. IOWA FARM FAMILY SCORES PAR IN CONVERTING TO GOLF COURSE. SCS, USDA, Des Moines, Iowa.
Smith, G. S. FARM-CITY TEAMWORK BOOSTS VIRGINIA RURAL AREA'S ECONOMY. SCS, USDA, Upper Darby, Pa.
Roth, B. A. WEST VIRGINIA WATERSHED PROJECT UPS FARMERS' INCOME--TOWN'S ECONOMY. SCS, USDA, Upper Darby, Pa.
Jackson, H. C. DISTRICT FARMERS PROFIT WHEN ST LOUISIANS "GO FISHING FOR FUN" SCS, USDA, Columbia, Mo.
Smith, R. H. BOBWHITES DRAW CITY HUNTERS TO GEORGIA CONSERVATION FARM. SCS, USDA, Perry, Ga.
Fox, L. FUN FOR 100 MAINE FAMILIES IN CONSERVATION FARMER'S WOODLAND. SCS, USDA, Upper Darby, Pa.
Nauss, J. WOMEN SEE WHERE FOOD COMES FROM. Coastal Soil Conserv. Dist., Beaumont, Tex.

BIOLOGY

Fish

Regier, H. A. ECOLOGY AND MANAGEMENT OF LARGEMOUTH BASS AND BLUEGILLS IN FARM PONDS IN NEW YORK. N.Y. Fish and Game J. 10: 1-89. 1963.

To construct a factual and reasoned basis for a fish-stocking and management policy applicable to farm ponds in New York, various species and species combinations were studied. Results of largemouth bass (Micropterus salmoides) and bluegills (Lepomis macrochirus) stocked according to three different formulae were reported. Data on survival growth, reproduction, standing crops, harvests, and population condition were summarized and compared. Pond-owner preferences and practices, and pond costs, were determined.

It was concluded that a bass-bluegill combination might prove satisfactory in: (1) Larger, deeper New York ponds whose surface temperatures rise above 80° F. for several weeks each summer; (2) ponds where weeds can be controlled; and (3) ponds whose owners have a genuine interest in fishing and managing the pond for bluegills as well as bass. A majority of farm ponds in New York do not meet these criteria.

Lake Erie Fish Res. Sta., Dept. Land & Forest, Wheatley, Ontario, Canada.

Nichols, P. R., and Massmann, W. H. ABUNDANCE, AGE, AND FECUNDITY OF SHAD, YORK RIVER, VA., 1953-59. Fishery B. 63(1): 179-187. 1963.

A study of the American shad fishery of the York River, Va., during 1959 showed an estimated total catch of 463,000 pounds, a fishing rate of 55.2 percent, and a total population of 839,000 pounds. Additional estimates of catch and effort were used to calculate fishing rate and population size for each year 1953 through 1958. Analyses of scales showed that most shad spawn at 3, 4, and 5 years of age and approximately 23 percent of the fish caught during the 1957-59 seasons had spawned the previous year. The number of ova produced by York River shad ranged from 169,000 to 436,000 per fish.

Bur. Commercial Fisheries Biol. Lab., Beaufort, N.C.

Jones, B. R., and Moyle, J. B. POPULATIONS OF PLANKTON ANIMALS AND RESIDUAL CHLORINATED HYDROCARBONS IN SOILS OF SIX MINNESOTA PONDS TREATED FOR CONTROL OF MOSQUITO LARVAE. Trans. Amer. Fisheries Soc. 92: 211-215. 1963.

Short-term effects of DDT upon summer populations of plankton animals in some Minnesota ponds were reported. DDT in bentonite and vermiculite granules was applied to three ponds in amounts used routinely for mosquito control: 1 pound per acre in early spring, and lesser amounts later as needed. By such application, the nearly insoluble DDT was distributed in a thin layer on the pond bottom. Three similar ponds, which were not treated with DDT during the 11-week study period, served as controls. However, all six ponds had been treated with DDT in one or both of the 2 preceding years.

Averages of counts of cladocerans, copepods, ostracods, rotifers, and Volvox were of the same general magnitude for treated and control ponds. The crustacean counts from these ponds were similar to those reported from ponds in the St. Paul area investigated prior to the mosquito control program. A few days after treatment, however, there was indication of a depression of microcrustacean populations followed by apparent rapid recovery. Analyses of soils from the weedy margins of study ponds showed DDT concentrations ranging from 1.5 to 25.5 p.p.m. There were also small amounts of DDD and DDE in several of the soils. Heptachlor epoxide, which had not been used in the mosquito control program, was also found in soils from two of the ponds.

Minn. Dept. Conserv., St. Paul, Minn.

Smith, L. L., Jr., and Kramer, R. H. SURVIVAL OF WALLEYE EGGS IN RELATION TO WOOD FIBERS AND SPHAEROTILUS NATANS IN THE RAINY RIVER, MINNESOTA. Trans. Amer. Fisheries Soc. 92: 220-234. 1963.

Walleye (Stizostedion vitreum vitreum) eggs were incubated in a temporary jar hatchery using Rainy River water taken below paper mills discharging sulfite, kraft, insulating board, and groundwood wastes. Eggs were also incubated in trays held on and off the bottom in the river below mills, above the mills, and in tributary streams. In 2 years, survival of eggs in jar controls was 31.2 to 73.5 percent. Survival to hatching of eggs jar-incubated in polluted water was 0.02 to 6.0 percent. At river stations below mills survival of tray eggs on bottom did not exceed 1.2 percent; and off bottom, 3.5 percent. Eggs held on bottom above mills had maximum survival of 37.6 percent; and off bottom, 49.1 percent. In most experiments in polluted Rainy River water, the principal cause of mortality was Sphaerotilus growths on the eggs which prevented successful emergence of fry. Prior to hatching, egg-survival rate in jars was similar in controls and in experiments. Chemical treatment to remove slime increased hatch of eggs. Sphaerotilus-covered eggs removed to fresh water lost the bacterium and hatched at a high rate. Some bottom deposits below mills were toxic to eggs.

U. Minn., St. Paul, Minn.

Regier, H. A. A COST ANALYSIS OF FARM PONDS IN TOMPKINS COUNTY, NEW YORK. Prog. Fish-Cult. 25: 144-148. 1963.

Part of the results of a cost analysis of farm ponds in Tompkins County, New York, was summarized in the following tables:

TABLE 1.--Present value of pond costs, other than those directly associated with fish management, expected to be incurred over a 20-year period

Item	0.3-acre pond	1.0-acre pond
Value of land use foregone	$20	$60
Cost of planning, designing, and supervising	125	125
Construction costs	530	1,580
Landscaping and fencing	100	180
Risk from:		
Flooding	70	210
Leaking	10	25
Pest control and miscellaneous repairs	160	240
Total	1,015	2,420
Average annual equivalent	78	187

TABLE 2.--Present value of costs of managing ponds for fish and fishing over a 20-year period

Item of cost	0.3-acre pond				1.0-acre pond			
	Extensive trout	Intensive trout	Bass and shiners	Bass and bluegills	Extensive trout	Intensive trout	Bass and shiners	Bass and bluegills
Stock................	$120	$340	$15	$30	$400	$1,135	$50	$100
Reclamation......	5	5	10	10	15	15	30	30
Fertilization and weed control...	50	50	50	130	155	155	155	420
Total..........	175	395	75	170	570	1,305	235	550

TABLE [3]--Present value of the total costs and average annual equivalent costs incurred in building, maintaining, and properly managing a pond for fish and fishing over a 20-year period

Fish combination managed	Present value of the costs		Average annual equivalent	
	0.3-acre pond	1.0-acre pond	0.3-acre pond	1.0-acre pond
Trout, extensive..	$1,190	$2,990	$92	$230
Trout, intensive..	1,410	3,725	108	287
Bass and shiner..	1,090	2,655	84	205
Bass and bluegills..................................	1,185	2,970	91	229
No fish..	1,015	2,420	78	187

Lake Erie Fish. Res. Sta., Dept. Land & Forest, Wheatley, Ontario, Canada.

Upland Wildlife

Smith, J. G. A SUBALPINE GRASSLAND SEEDING TRIAL. J. Range Mangt. 16: 208-210. 1963.

In a species trial at the 5,700-foot elevation in north-central Washington, 14 grasses and 8 legumes were planted.

Timothy, pubescent wheatgrass, orchardgrass, blue wildrye, big bluegrass, meadow brome, and slender wheatgrass were rated excellent or good after eight growing seasons. Bearded wheatgrass was the only species that failed to make a stand the first year. The three alfalfas (Nomad, Sevelra, and Ladak) and chickpea milkvetch made good stands the first year but declined rapidly and were gone except for small remnants after 3 years. Flat peavine, birdsfoot deervetch, and bramble vetch were well established in hand-plantings after four growing seasons and were heavily utilized by deer. Sainfoin made a poor stand the first year and disappeared soon thereafter. A favorable but short-lived response to nitrogen application was noted in the grasses. In spite of the relatively unpalatable herbage now produced on many subalpine ranges, they probably retain their high potential productive capacity wherever cover has been sufficient to protect the soil from erosion.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Oreg.

Peek, J. M. APPRAISAL OF A MOOSE RANGE IN SOUTHWESTERN MONTANA. J. Range Mangt. 16: 227-231. 1963.

Studies of willow, silverberry, bog birch, and aspen located on a moose range in southwestern Montana were reported. Willow and silverberry located on a moose winter concentration area were more heavily utilized than were willow and bog birch located at higher elevation; however, all appeared to have received heavy utilization. Although the area was also used by elk, mule deer, cattle, and sheep, moose apparently were the major influence upon the browse species examined.

Montana Fish and Game Dept., Ennis, Mont.

SUPPLEMENT

Problems Indirectly Affecting the Application of Soil and Water Conservation Practices

Burnside, O. C., Fenster, C. R., and Wicks, G. A. DISSIPATION AND LEACHING OF MONURON, SIMAZINE, AND ATRAZINE IN NEBRASKA SOILS. Weeds 11: 209-213. 1963.

The fate of monuron and atrazine in Wymore sicl at Lincoln, Bridgeport l soil at North Platte, and Rosebud l soil at Alliance, Nebr., was followed during a 16-month period. Oats grown for 40 days in the field as a biossay crop showed that simazine and atrazine were less phytotoxic in the finer textured soil where the rainfall was highest. Soybean bioassays in soil from different horizons showed a higher concentration of monuron remaining in the 0- to 3-inch soil horizons than of simazine or atrazine. There was a marked decrease of monuron phytotoxicity in the 3- to 18-inch soil layer 16 months after as compared to 4 months after the herbicide application. Atrazine showed the greatest leaching of the three herbicides.

U. Nebr., Lincoln, Nebr.

De Vries, M. L. THE EFFECT OF SIMAZINE ON MONTEREY PINE AND CORN AS INFLUENCED BY LIME, BASES, AND ALUMINUM SULFATE. Weeds 11: 220-222. 1963.

Application of simazine generally reduced dry weight of tops and roots of corn and Pinus radiata seedlings. Simazine always increased top-root ratios of corn but generally decreased those of pine seedlings. Simazine increased significantly the uptake of N by corn in all soils; of Mg and P in limed, and of K in acidified soils. Aluminum sulfate decreased injury from simazine. Lime at 3 tons per acre mixed into the soil exerted a synergistic effect on the activity of 12 pounds per acre of simazine and killed all pine seedlings in the 7th or 8th week after sowing. The death of the seedlings was caused by excess calcium ions and not by pH.

Staff Agron., Geigy Chemical Corp., Ardsley, N.Y.

Kring, J. S. SERVICEABILITY OF FARM-TREATED FENCE POSTS. Tenn. Agr. Expt. Sta. B. 356, 15 pp. 1963.

A study was begun in 1947 on the cutting, preservative treatment, and serviceability of fence posts from six species--shortleaf pine, red maple, post oak, white oak, scarlet oak, and blackjack oak. None of the posts treated with pentachlorophenol (5-percent solution in diesel oil) had failed after 8 to 13 years in service. After 8 years in service, several posts of four species treated with copper naphthenate (0.5-percent metallic copper in diesel oil) had failed.

Observations on time required for cutting and peeling under selected conditions were given.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn.

Radioactive Fallout

Todd, F. A. NUCLEAR FALLOUT AND LIVESTOCK SURVIVAL. Agr. Engin. 44: 488-490, 493. 1963.

Procedures were described for survival of livestock until radioactivity is reduced to less hazardous levels and protection against consumption of contaminated feed and water.

TABLE.--EFFECT OF SHELTER ON THE MORTALITY RATE OF LIVESTOCK*

Kind of livestock and radiation exposure--unsheltered dose (number of roentgens--one day)	Mortality rate by nature of shelter			
	No shelter	Tight wooden barn (protection factor of 2)	2-story barn with loft full of hay (protection factor of 5)	Basement-type barn with loft full of hay (protection factor of 10 or more)
	Percent	Percent	Percent	Percent
Cattle				
500	30	0	0	0
1000	100	30	0	0
3000	100	100	80	0
Hogs				
500	30	0	0	0
1000	100	30	0	0
3000	100	100	50	0
Sheep				
500	38	0	0	0
1000	100	38	0	0
3000	100	100	80	0
Poultry				
500	10	0	0	0
1000	64	10	0	0
3000	100	100	20	0

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*The reduction of radiation by shelter is described as the "protection factor." For example, if the protection factor of any given structure is 2, then the intensity of outside radiation is reduced by one-half. In fallout areas, one-half or more of the radiation would be released after the end of the first day.

Many different radioisotopes are created by a nuclear explosion. Most of them are of minor importance because the amounts are small, their half-life is extremely short, and they don't find their way into the food chain where they could affect man and animals.

But four of these isotopes are capable of entering the food chain and contaminating both food crops and foods of animal origin: Cesium 137; iodine 131; strontium 89; and strontium 90.

Cesium 137 is chemically similar to the essential element potassium. When consumed and absorbed, this radioisotope is found primarily in the soft tissues. However, like potassium, it is not retained long in the body and is rapidly secreted in the milk or excreted in the wastes.

Iodine 131 comes down in large quantities in fresh fallout. Because of its similarity to ordinary iodine, this isotope can accumulate in the thyroid gland and is also secreted in the milk from dairy animals. Iodine 131 has a relatively short half-life of 8 days but might be a major internal hazard during the first 60 days following a nuclear attack.

As the first few months pass following an attack, strontium 90 would take on new significance. Decay of the shorter-lived isotopes would leave strontium 90 as the principal material of radioactive contamination. In addition, the extremely small particles of strontium 90 that has been carried into the stratosphere would be gradually reaching the earth in increasing quantities. In contrast to iodine 131, which has a half-life of 8 days, strontium 90 has a half-life of 28 years. Furthermore, strontium gains entrance into the food chain, where it behaves much like calcium in soils, plants, man, and animals.

Strontium 89 is similar to strontium 90, except that it has a shorter half-life of 53 days.

ARS, USDA, Washington, D.C., 20250

Romney, E. M., Nishita, H., Olafson, J. H., and Larson, K. H. ROOT TRANSFER OF FISSION PRODUCTS FROM CONTAMINATED SOIL. Soil Sci. Soc. Amer. Proc. 27: 383-385. 1963.

Dry yield of wheat grown for 117 days was not affected by solutions of nuclear reactor-produced mixed fission products (MFP) applied to the soil surface or mixed with equal amounts of potted soil at contamination levels ranging from 0.01 to 1.0 μc. beta activity per g. of soil. Concentrations of beta and gamma activity in the above ground parts of plants were increased as the soil contamination levels increased. Wheat removed from 0.07 to 0.09 percent of the total beta activity that had been mixed with the soil and from 0.10 to 0.15 percent of that which had been applied on to the soil surface. Concentrations of radioactivity in above ground plant parts were highest in leaves, intermediate in stems, and lowest in fruiting heads. Radiostrontium accounted for 50 to 80 percent of the beta activity transferred to above-ground plant parts; $<$ 10 percent was attributable to root transfer of Y-91, Ru-106, Cs-137, and Ce-144 from soil.

U. Calif., Los Angeles, Calif.

Evans, E. J., and Dekker, A. J. THE EFFECT OF POTASSIUM FERTILIZATION ON THE Sr90 CONTENT OF CROPS. Canad. J. Soil Sci. 43: 309-315. 1963.

Three soils were used in greenhouse experiments to determine the effect of KCl and K_2CO_3 on the Sr-90 concentration in oats, alfalfa, and timothy. In addition, soils were moist incubated to determine the effects of similar potassium treatments on water soluble Sr-90, calcium, and potassium.

In the greenhouse experiments, increasing levels of added potassium caused decreases in calcium, magnesium, and Sr-90 contents and increases in potassium contents of the crops. The decreases of Sr-90 were frequently greater when potassium was applied as the carbonate compared with its addition as the chloride. There were some exceptions to these trends. For instance, Sr-90 concentrations in oat grain increased with the addition of KCl to two of the soils. Increases in Sr-90 content were also found for timothy grown in one of the soils when KCl was applied.

The greater apparent effectiveness of K_2CO_3 in reducing Sr-90 content of crops compared with the addition of the chloride was explained in part by the results of incubation experiments, where KCl caused increases in water soluble Sr-90 whereas K_2CO_3 caused either smaller increases or decreases.

Canada Dept. Agr., Ottawa, Ontario, Canada.

Shirshova, R. A. EFFECT OF POTASSIUM FERTILIZERS ON THE UPTAKE OF RADIOACTIVE STRONTIUM BY PLANTS. Soviet Soil Sci. 3: 263-269. Mar. 1963.

Experimental results on the effect of potassium and calcium on the strontium-89 and strontium-90 by oats and buckwheat from various groups of soil in Russia were given.

The authors concluded that the addition of potassium fertilizers to the soil, as well as the addition of lime, can serve as one method of reducing the uptake of radioactive strontium by plants from the soil and its accumulation in the harvest.

Scripta Technica Inc., 1000 Vermont Ave., N.W., Washington, D.C., 20005

Mather, J. R., and Nakamura, J. K. THE CLIMATIC AND HYDROLOGIC FACTORS AFFECTING THE REDISTRIBUTION OF STRONTIUM IN SOILS. Pub. Climatology 15(1): 110 pp. 1962.

The influence of climatic and hydrologic factors on the movement of strontium through the upper layers of the soil were studied. The authors made the following conclusions:

1. Strontium that had fallen out of the atmosphere was found to move through the upper part of the soil profile at a rate determined by the volume of leaching solution present and the chemical and cation exchange properties of the soil solution. This rate of movement can be predicted on the basis of physical laws of mass movement.
2. A mathematical model of movement was established which permits computation of strontium movement in the soil. To use the mathematical model information on: (1) Initial concentration of strontium; (2) leaching volume; and (3) the leaching efficiency of the soil and water solutions are needed.
3. The volume of the leaching solution is the climatic water surplus or the excess precipitation when the water holding capacity of the soil is filled. The water surplus can be computed on either a daily or monthly basis by means of a bookkeeping procedure devised by Thornthwaite (1945) or on an annual basis for the surface layer of the soil by means of nomograms given.
4. A manual for using high speed computers to compute the factors of the daily water balance was prepared. This manual discusses the use of the computers and presents the necessary program for the computation of the daily water surplus, deficit, actual evapotranspiration, and water storage.

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5. The influence of the soil solution in determining the rate of movement of strontium can be expressed in terms of the factor, leaching efficiency, which is found to depend principally on the cation exchange capacity of the soil and the chemical composition of the leaching solution.
6. Leaching efficiency varies geographically from high values in moist regions to low values in dry regions for soils of the same texture. Thus, it requires more water to leach a given quantity of strontium in a dry region than in a moist region.
7. Leaching efficiency is related to the moisture index. Tables and nomograms were prepared to permit the determination of leaching efficiency from the readily available climatic data.
8. From the data on volume of the leaching solution and the leaching efficiency, it was possible to determine the rate of redistribution of strontium in the upper layers of the soil at a large number of stations and to plot the results on maps for analysis. Maps showing the time in years for 99 percent removal of strontium from the upper 6 and 12 inches of the profile of a sandy loam soil were prepared. These show a large region of fairly rapid removal of strontium in the southeastern part of the United States, with strontium removal time increasing regularly westward across the Great Plains and more rapidly and erratically in the mountainous regions of the west. For most of the agricultural or highly populated areas of the country, 99 percent of the initial concentration of strontium would be removed from the first foot of soil within 10 years under normal climatic conditions. Similar maps could be made for other soil types. They would show that strontium removal time decreased by approximately one-half for sands and increased by about four times in clay soils.

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Titlyanova, A. A. BEHAVIOR OF CESIUM AND RUBIDIUM IN SOILS. Soviet Soil Sci. 3: 277-283. Mar. 1963.

To study the adsorption of cesium and rubidium in soil, dynamic experiments were conducted with soil columns, as well as static experiments under equilibrium conditions to determine the influence of extraneous cations and of the concentration of the elements on their sorption and desorption in soils.

Micro-quantities of cesium had a very low mobility in the soil. They were almost completely sorbed by the first layer of the soil column and were not desorbed at all by lake water. A greater stability of the bond between the soil and micro-quantities of cesium, as compared to micro-quantities of rubidium, was also found in the static experiments.

The results of experiments on the desorption of cesium and rubidium by various cations, as well as the difference in the relationship between the behavior of these elements and their concentration in the soil let us assume that there are three forms of adsorbed cesium and two forms of adsorbed rubidium. The predominance of one or the other form in the soil depends on the concentration of the element adsorbed. The specific sorbed form of cesium predominates at micro-concentrations (lower than 10^{-7} eq./g. of soil, in these experiments) bound cesium predominates in the range of concentrations from 10^{-5} to 10^{-7} eq./g. of soil, and exchangeable cesium predominates at a concentration of 10^{-4} eq./g. of soil. The exchangeable form of rubidium predominates at a concentration of 10^{-4} eq./g. of soil, and the bound form, starting at a concentration of 10^{-5} eq./g. of soil and lower.

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